USBEE QX

USERS MANUAL

CWAV, Inc.

www.usbee.com

USBEE QX

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USBee QX User's Manual, Version 1.5

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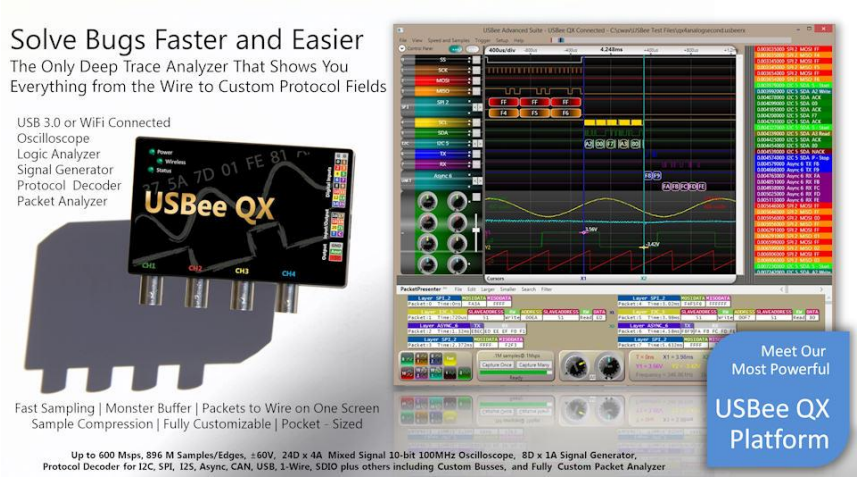
INTRODUCING THE USBEE QX POD


Solve Bugs Faster and Easier
The Only Deep Trace Analyzer That Shows You Everything from the Wire to Custom Protocol Fields
USB 3.0 or WiFi Connected
Oscilloscope
Logic Analyzer
Signal Generator
Protocol Decoder
Packet Analyzer
USBee QX
Fast Sampling | Monster Buffer | Packets to Wire on One Screen
Sample Compression | Fully Customizable | Pocket - Sized
Meet Our Most Powerful
USBee QX Platform
Up to 600 Msps, 896 M Samples/Edges, ±60V, 24D x 4A Mixed Signal 10-bit 100MHz Oscilloscope, 8D x 1A Signal Generator,
Protocol Decoder for I2C, SPI, I2S, Async, CAN, USB, 1-Wire, SDIO plus others including Custom Busses, and Fully Custom Packet Analyzer

The Tools You Need - All In One Place

Introducing the Ultimate PC-Based Programmable Multifunction Mixed Signal Oscilloscope - Logic Analyzer with I2C, SPI, Async, SDIO, 1-Wire, CAN protocol decoders, Digital Signal Generators, Frequency Counter and integrated Protocol Analyzers in a compact and easy to use USB Test Pod.

Designed to Solve Your Toughest Problems

Using patented technology, the USBee QX has 4 analog and 24 digital channels, 100MHz to 600MHz sampling depending on channels used, 896 million sample internal buffers, Quad 10-bit ADC's, independent 100Msps 8 channel Digital Signal Generator, 7Msps Analog Signal Generator, +/- 60V protection on all inputs, Variable Logic Thresholds and USB over current protection. That's just the hardware.

Mixed-Signal Multi-level Protocol Decoding

Combined with the USBee QX Suite software, the USBee QX becomes a multi-layer protocol decoder for many of today's serial and parallel busses, letting you debug at the waveform, bus data, or packet level.

In-Field Upgradable System Supports Addition of New Features

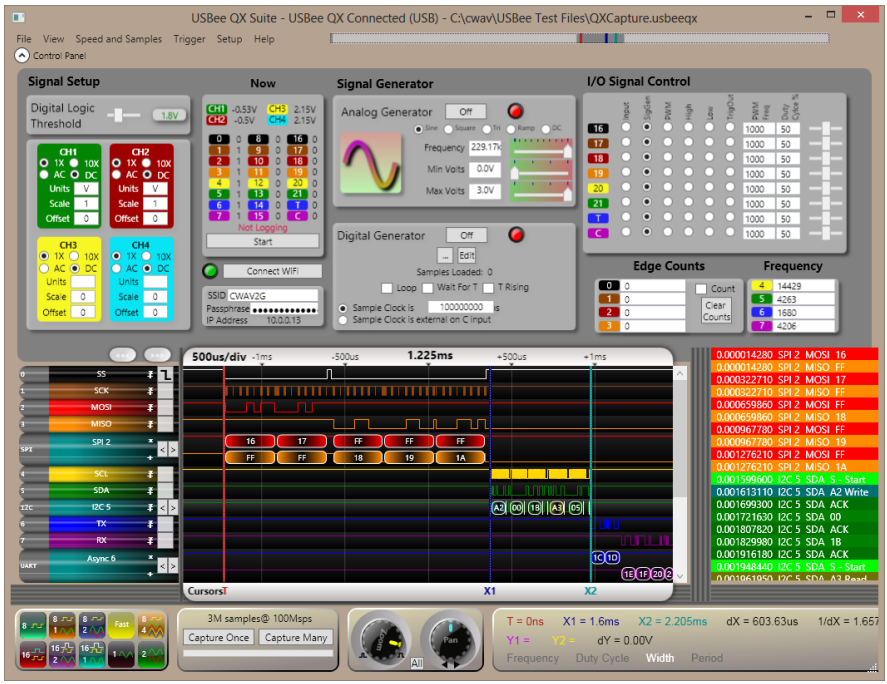
Based on a proprietary design that allows the software, firmware and hardware to be dynamically reconfigured using web-based software downloads, the USBee QX and its ever growing list of Applications ensures that you will always have the most current tools available for years to come.

With a single USB connection to your laptop or PC, the USBee QX gives you the power to design, prototype, test, and validate your mixed signal electronic designs with seamless ease. Built upon the popular, award-winning and patented USBee mixed signal Oscilloscope, Logic Analyzer, Signal

Generator, and Protocol Analyzers, the USBee QX takes full advantage of the powerful debug capabilities of the USBee QX Suite software to solve your problems fast!

The USBee QX Test Pod does not need an external power supply. The USB bus supplies the power to the pod, so your PC will be supplying the power. The Pod does, however, require a self powered hub (not bus powered) if a hub is used between the PC and Pod.

The included power supply is required for WiFi use.



THE USBEE QX TEST POD

The USBee QX Test Pod has four sets of connectors:

- USB
  - Connects to the PC via 6 foot USB cable (USB 3.0 or USB 2.0 compatible)
- CH1, CH2, CH3, CH4
  - Analog Input Channels
  - BNC connectors for standard oscilloscope probes
  - +/- 60V tolerant
  - Sampled at up to 100MHz
- Digital Inputs Connector
  - 18 pins (9x2) – 2 Ground (G) and 16 Digital inputs (0-15)
  - 0.1” spaced 0.025” square header pins
  - +/-60V tolerant inputs
  - Connects to 1x2 pin Ground test lead set and 2 4x2 pin signal test lead sets
  - Sampled at up to 600MHz
- Digital Input/Outputs connector
  - 8 pins – 8 Digital Inputs or Outputs (16 – 21, plus T and C)
  - Mode is set from USBee QX Suite Control Panel
  - 0.1” spaced 0.025” square header pins
  - Digital Output pins are 0-2.5V logic with 600ohm series current limiting resistor
  - Outputs clocked at up to 100MHz
  - +/-6V tolerant inputs
  - Inputs sampled at up to 600MHz
  - Connects to 4x2 pin test lead set
- Analog Outputs connector
  - 3 pins – 1 Ground (GND), 1 Analog Aout, 1 +5V Supply
  - 0.1” spaced 0.025” square header pins
  - +5V output – actually VBus connected directly to the USB VBus signal from the PC through a resettable fuse, or from the included power supply
  - 1 Aout analog output pin used by the Analog Signal Generator function (0-3V levels)
  - Connects to single leads (Grey, Red, Green)

WARNING

The USBee is galvanically isolated when connected via WiFi, but is NOT galvanically isolated when connected via USB. This mainly concerns systems where the target circuit AND the PC are plugged into AC power outlets. If your target system OR the PC (Laptop) are battery powered, there is no issue. If your PC and target circuit have different ground reference levels, connecting them together using the USBee GND signal can damage the devices.

To ensure both your PC and target system share the same ground reference, do the following:

1. Use polarized power cords for both the PC and target and plug them into the same AC circuit.

   If you use non-polarized power cords or use separate power circuits, the PC and target system may have different ground references which can damage the USBee, target and/or PC.

2. Ensure that a GND signal on the USBee is connected to the target ground (and not another voltage level).

3. Or, use the USBee in WiFi connected mode. This gives a galvanically isolated setup.

Also,

As with all electronic equipment where you are working with live voltages, it is possible to hurt yourself or damage equipment if not used properly. Although we have designed the USBee QX pod for normal operating conditions, you can cause serious harm to humans and equipment by using the pod in conditions for which it is not specified.

Specifically:

- ALWAYS connect at least one GND line to your circuits ground
- NEVER connect the digital signal lines (0 thru 21, T and C) to any voltage other than between -60 to +60 Volts
- NEVER connect the analog signal lines (CH1, CH2, CH3, CH4) to any voltage other than between -60 and +60 Volts
- The USBee QX actively drives Pod signals AOUT and 16 through 21 and T and C. Make sure that these pod test leads are either unconnected or connected to signals that are not also driving. There is a current limiting series resistor (680 ohm) in each of these lines in case of short.
- Plug in the USBee QX Pod into a powered PC BEFORE connecting the leads to your design.

PC SYSTEM REQUIREMENTS

The USBee QX Test Pod requires the following minimum PC features:

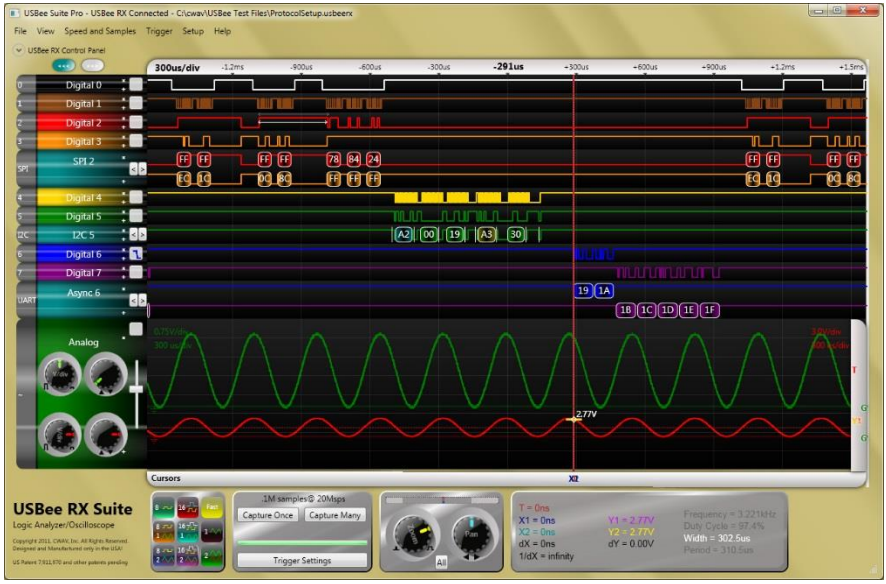
- Windows® XP, Vista, 7 or 8 32-bit or 64-bit operating system
- MAC OSX running VFusion or Parallels with one of the above
- Pentium or higher processor
- One USB 3.0 Super Speed or USB2.0 High Speed enabled port. It will not run on USB 1.1 Full Speed ports.
- 32MBytes of RAM
- 125MBytes of Hard disk space
- Internet Access (for software updates and technical support)
- 802.11 B/G Wireless network for WiFi operation

EACH PACKAGE INCLUDES

The USBee QX contains the following in each package:

- USBee QX Test Pod
- 4 100MHz oscilloscope probes with x1 and x10 selection
- One 8 lead 9-inch signal generator cable set
- Two 8 lead 9-inch logic analyzer cable sets
- One 2 lead Ground cable set
- 3 lead 9-inch analog cable set
- 24 high performance micro grabber test clips
- 6 foot USB cable
- Power supply adapter
- USBee QX Suite Software (downloaded)
- USBee QX Suite Manuals (downloaded)

INTRODUCING THE USBEE QX SUITE



The USBee QX Suite is powerful electronic signal analysis software for your USBee QX Test Pod. It starts out as an easy to use Logic Analyzer, Oscilloscope, Signal Generator, Frequency Counter and PWM Controller and adds serial bus decoding and world class configurability that lets you solve your electronic problems quickly! This chapter details the operation of the USBee QX Test Pod running the USBee QX Suite software.

USBEE QX SUITE OVERVIEW

The USBee QX Suite is a powerful mixed signal analyzer that on the USBee QX Test Pod. It is available for free from USBee.com and will run without restriction.

The USBee QX Suite Standard will run in Demo mode without a USBee, or on any USBee QX Test Pod. It will not work on any other USBee test Pod model.

USBee QX Control Panel Visible

SEE THE INFORMATION YOU WANT FAST!

Setup of the USBee QX Suite is fast! Capturing the data you need to solve your problems is just as fast. You can see your design in action with just one click thanks to the easy to use trigger settings, color coded signals and automatic buffer and sample rate settings.

DATA ACQUISITION OVER USB 3.0

Capture from 100 to 600 million samples per second for sample buffer depths of up to 32 million samples or 16 million transitions.

SUPERIOR QUALITY DESIGN - PROFESSIONAL RESULTS

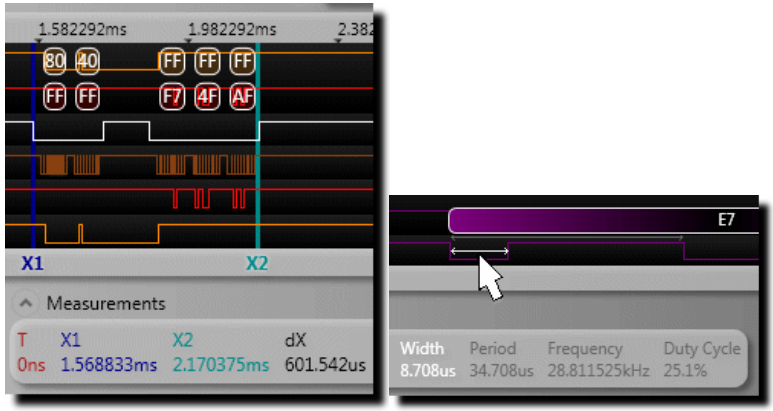
The USBee QX Suite takes full advantage of the power the USBee QX Test Pod. Each USBee QX comes with the best color coded highly flexible test leads, the best test clips and our signature small and sleek design that can fit right in your pocket. We are proud to say the entire USBee product line is designed and manufactured in the USA!

FAST AND DETAILED WAVEFORM VIEWING

The USBee QX Suite lets you capture a huge amount of data. Go exactly to the section of that data you want using the Quick Zoom with your mouse scroll wheel, or use the Overview bar to rip through your millions of samples or hone in on a specific section.

MEASURE IT

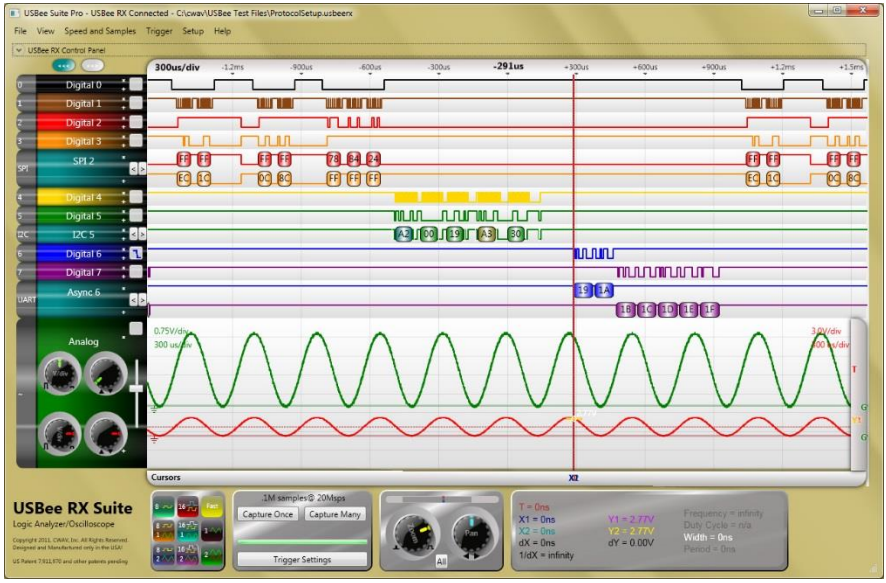
Should that pulse be 10ms? Measure it using our super easy edge snapping timing cursors. Better yet, you can use our Insta-Measure feature to instantly calculate the width, period, frequency and duty cycle of the waveform under the cursor.



FULLY CONFIGURABLE LOOK AND FEEL

View your signals like you like them. Want to add decoded bus traffic to the waveforms? Done! Want to delete waves from the screen? Done! Want to reorder waveforms for easier readability? Done! Want to resize the screen for easier reading or more data per screen? Done!

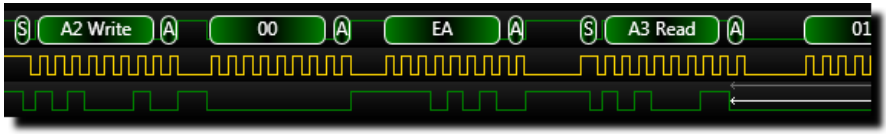
And you like Magenta? Well you can change cursor colors to suite your desires. Waveform backgrounds can also be customized, and you can even give the entire application that cool Glassy look that Vista has made so popular. Then again, if you like simple, white and black are also available. It's good that white ink cartridges are free!



USBee QX Suite showing SPI, I2C and Async decoding

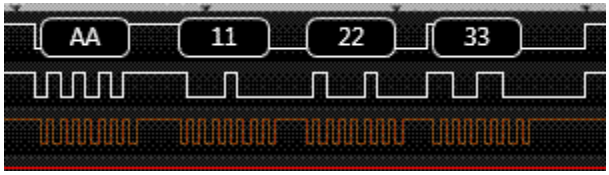
SERIAL BUS ANALYSIS

USBee QX Suite has decoding support for your favorite serial busses such as I2C, SPI and Async. Bus traffic is decoded in-line with the waveforms and can be displayed on top of, underneath, or instead of the voltage versus time waveform. Just place the cursor over the decoded traffic and get a see-through image that shows you the wiggles that made that byte!



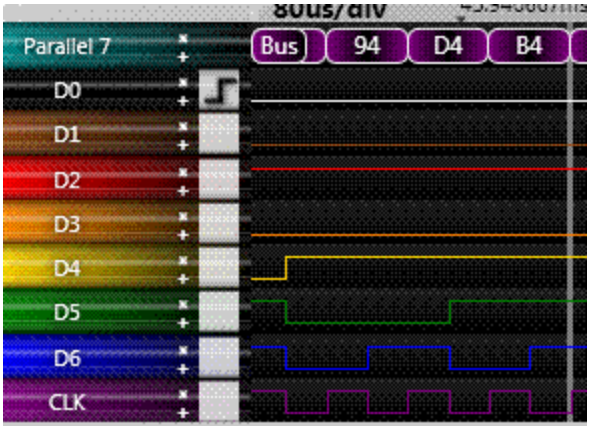
I2C Transaction

USB Transaction

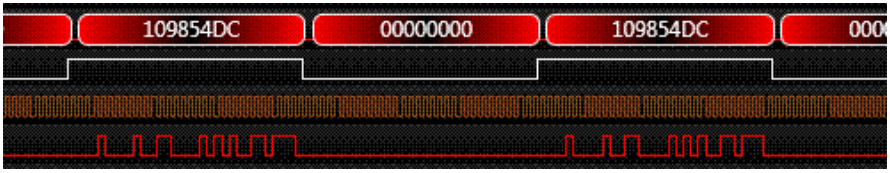


Synchronous Serial Transaction

PS2 Transaction



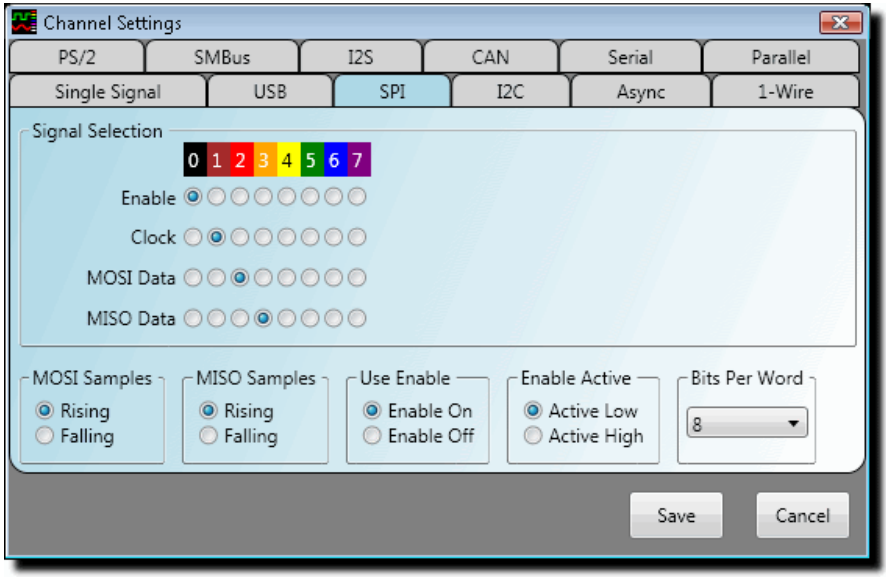
Parallel Bus Decode



I2S Decode

CAN Transaction

Serial Bus Setup is simple and straightforward - simply choose the signals for the bus and set how the bus is configured. Not sure how your design works? Not a problem. You can try different configuration settings and the busses will be decoded using those settings on the fly so you can get it right!



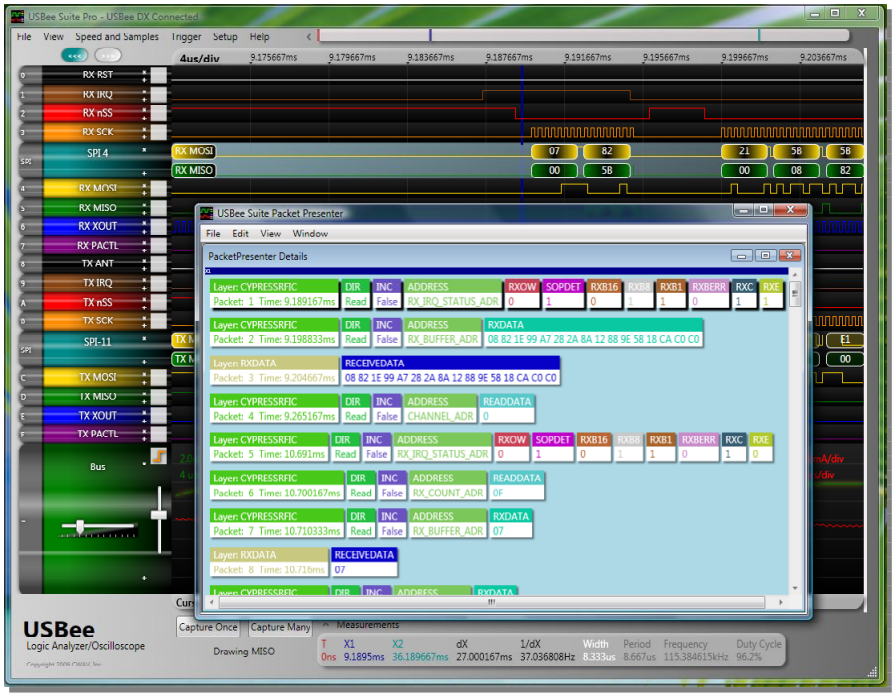
(USBee SX options shown above)

DATA STORAGE

Save your entire data capture to file quickly using the USBee QX Suite data format to be read back in later for viewing. Or you can export your captured data to files that you can work with. Want to import your waveform data into Excel? No problem! Just export it as a comma separated file and it imports directly without modification. Need the data in raw binary format? We've got that too!

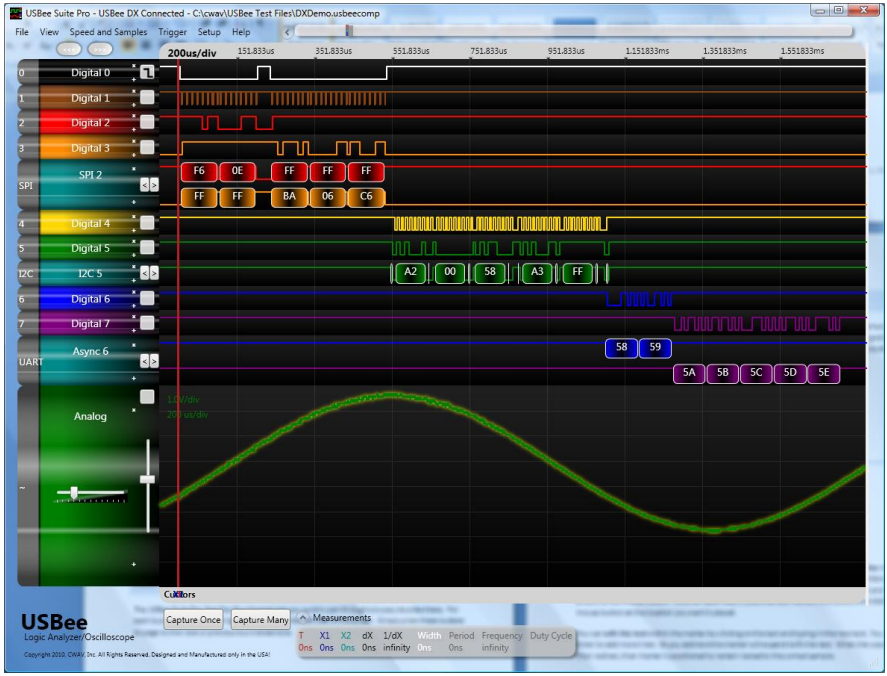
PACKETPRESENTER

The USBee QX Suite adds the PacketPresenter™ feature that runs alongside of the existing bus decoders. The PacketPresenter™ takes the output of raw binary data from the bus decoders and parses the stream according to users PacketPresenter Definition File for the intent of displaying the communications in easily understood graphical displays.



FAST PAN BUS VIEWING

The USBee QX Suite Fast Pan Bus Viewing lets you quickly pan through a busses decoded data. For each bus there is a left and right pan button on the left side of the screen. Simply press these buttons to page to the next or previous bus transactions.



HOT KEYS

The USBee QX has a full set of hot keys that lets you drive the acquisition of samples, setup configuration and quickly view your data using the keyboard.

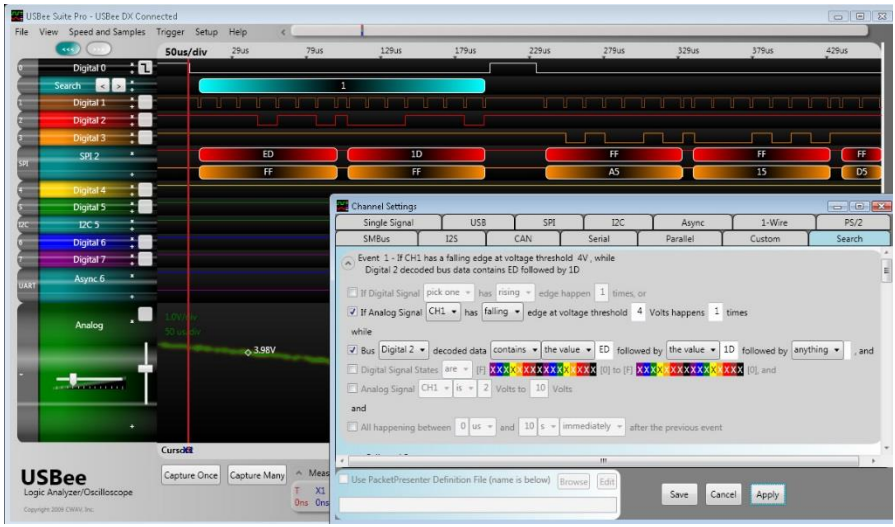
Key	Function
Left Arrow	Previous Edge/Packet
Right Arrow	Next Edge/Packet
Shift-Left Arrow	Pan Left
Shift-Right Arrow	Pan Right
Up Arrow	Previous Waveline
Down Arrow	Next Waveline
Home	Show the Start of capture buffer
End	Show the end of the capture buffer
Ins	Insert a new waveline below the current line
Del	Delete the current waveline
Space	Capture Once
1	Go to the X1 cursor
2	Go to the X2 cursor
A	Zoom out to view all of the capture buffer
B	Open the Waveline settings dialog box
D	Toggle the Decoder List window
I	Zoom In
O	Zoom Out
T	Go to the Trigger position

SMART SEARCH

USBee QX Suite Smart Search highlights the sections of your trace matching your areas of interest so that you don't need to waste time hunting for the data you need.

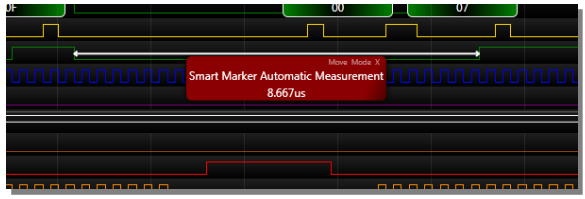
You can specify up to 32 levels of search events that are any combination of bus decoded traffic, states or edges of digital or analog signals, inside or outside of analog voltage ranges and/or digital ranges, and all validated by time specific windows.

Once specified you can pan through the occurrences of your searched items with the click of the mouse and see the total number of times the searched events occur.



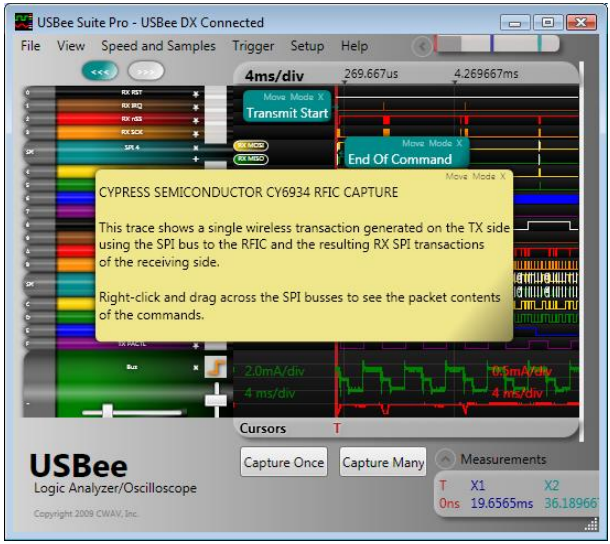
SAMPLE AND SMART MARKERS

Placing markers in your traces can help detail what is happening in your design. There are two types of markers that can be used. The first marker type locks itself to a sample on a waveform and lets you specify the text. The second is a Smart Marker that automatically measures the pulse width, frequency, period or duty cycle of the waveform at the marker location.



ANNOTATIONS AND STICKY NOTES

The USBee QX Suite adds Sticky Notes which you can use to further detail your traces for documentation purposes. You can also add Title and Footer text to your display that is saved with the trace file.



ACQUISITION CONTROL

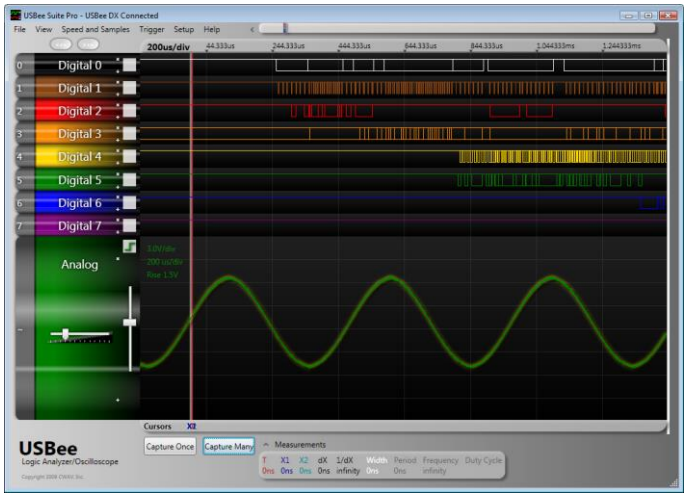
The USBee QX Suite adds more trace acquisition and triggering controls such as Normal Mode, Automatic Mode, Single Capture and Multiple Capture.

Normal mode will wait for the trigger event to occur before capturing. Automatic Mode will wait a set time for the trigger and will automatically trigger if it is not found.

Single Capture mode performs a one-shot capture of the signals. Multiple Capture repeatedly captures and displays the signals.

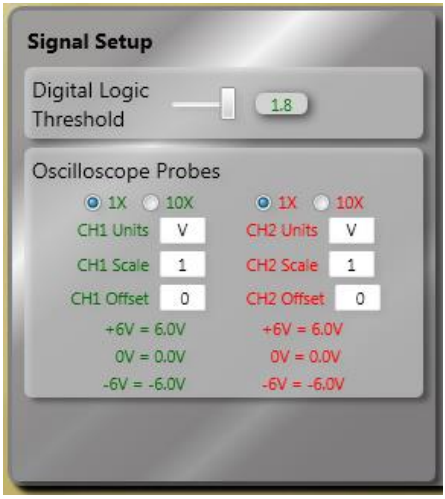
DISPLAY MODES

The USBee QX Suite lets you widen the trace waveforms, display the analog waveforms as vectors or single sample points, and persist the display from one trace to the next.



ANALOG CHANNELS SCALING

The USBee QX Suite provides a scaling ability to convert the analog voltages into other units of measurement.



USBEE SUITE DATA FILE IMPORTING

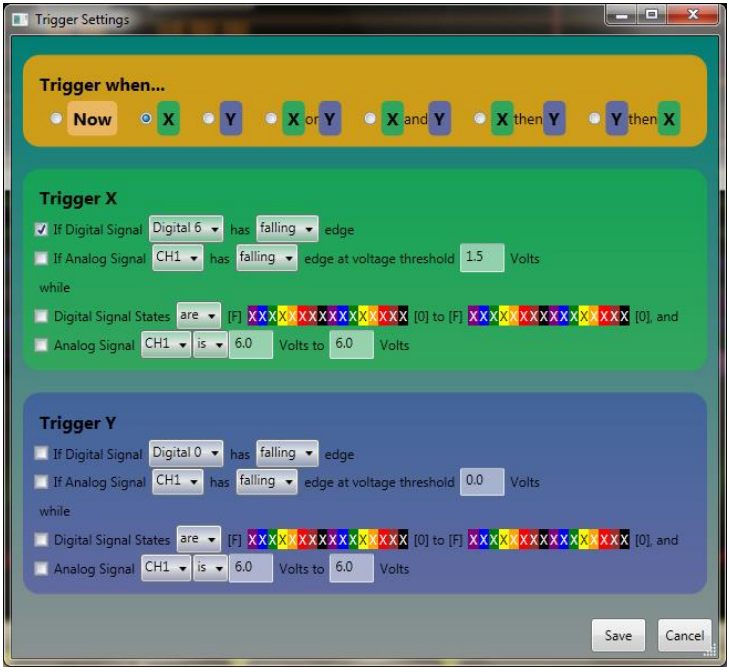
The USBee QX, AX or ZX running the USBee Suite software saves files in their own file format. These older files can be imported into the USBee QX Suite.

BROWSER-LIKE NAVIGATION

The USBee QX Suite adds browser-like Forward and Back buttons that let you quickly navigate through your trace display.

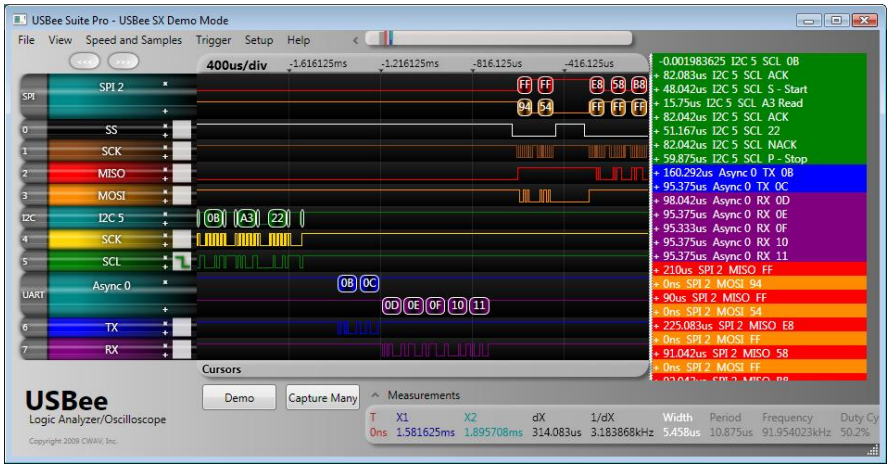
COMPLEX TRIGGERING

The USBee QX Suite adds a multi-level hardware trigger to capture the events you need to see to solve your problems.



RELATIVE TIME DECODE

The USBee QX Suite also adds a Relative Time or Absolute Time setting for the decoded data lists.



USBEE QX CONTROL PANEL

The USBee QX Suite contains a Control Panel that controls many of the features of the USBee QX system, including the Variable Logic Threshold, Analog channel scaling, Current Logic and Analog levels, Analog Signal Generator, Digital Signal Generator, PWM controllers, Pulse Counters and Frequency Counters.

QUICK START

This section goes through installing the software for your USBee QX and getting you using the USBee QX quickly.

PC SYSTEM REQUIREMENTS

The USBee QX Suite requires the following minimum PC features:

- Windows® XP SP3, Vista or Windows 7/8 32-bit or 64-bit operating system
- .NET Framework 4.0 or greater. This is installed automatically during installation if not already on your PC.
- Pentium or higher processor
- One USB 3.0 High Speed enabled port. It will not run on USB 1.1 Full Speed ports.
- 32MBytes of RAM
- 125MBytes of Hard disk space
- Internet Access (for software updates and technical support)
- 802.11 B/G Wireless network for WiFi

SOFTWARE INSTALLATION

To ensure that you are using the latest version of USBee QX software, you can download the software from our web site at www.usbee.com. You must install the software on the PC before you plug in the USBee QX device.

A quick guide to install the software follows:

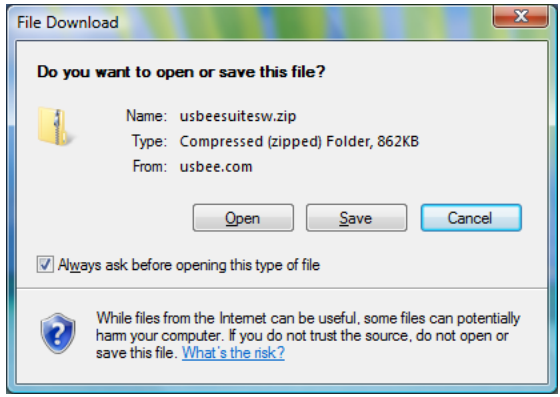
- Download the USBee QX Software from http://www.usbee.com/download.htm and open the usbeeQXsuitesw.zip file.
- Run the SETUP.EXE.
- Follow the instructions on the screen to install the USBee QX software on your hard drive. This may take several minutes.
- Now, plug the included USB A to USB Superspeed cable into the USBee QX and the other end into a free USB 3.0 High Speed port on your computer.
- You will see a dialog box indicating that it found new hardware and is installing the software for it. Follow the on screen directions to finish the driver install.
- The USBee QX Software is now installed.
- Run the USBee QX Suite software by going to the Start | Program Files |USBee QX Suite.
- If your PC does not already have .NET Frameworks version 4.0 or greater, you will be notified to download and install this from the Microsoft web site.

DETAILED SOFTWARE INSTALLATION

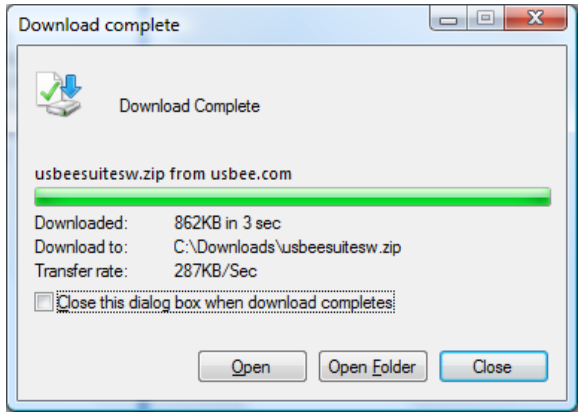
The USBee QX Suite software is available for download from www.usbee.com/download.htm. It will run in a demonstration mode if you do not have a USBee QX Pod installed and attached.

To install the USBee QX Suite software:

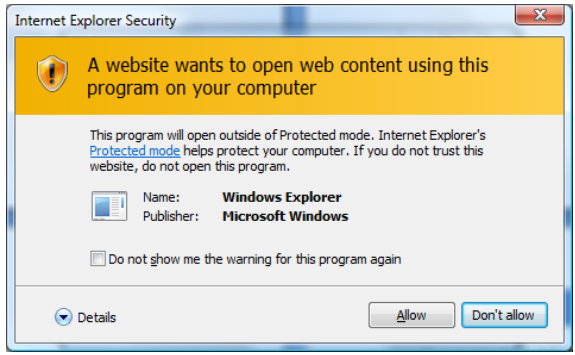
- Click the USBee QX Suite Software link at http://www.usbee.com/download.htm and click SAVE to save the software to a known directory.


File Download
Do you want to open or save this file?
Name: usbeesuitesw.zip
Type: Compressed (zipped) Folder, 862KB
From: usbee.com
Open
Save
Cancel
Always ask before opening this type of file
While files from the Internet can be useful, some files can potentially harm your computer. If you do not trust the source, do not open or save this file. What's the risk?

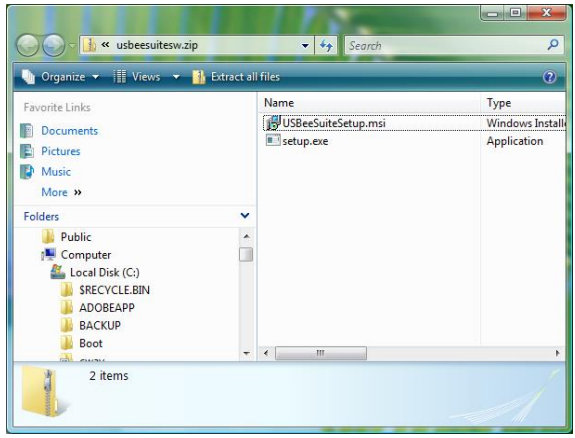
- Open the ZIP file you just downloaded by clicking OPEN.



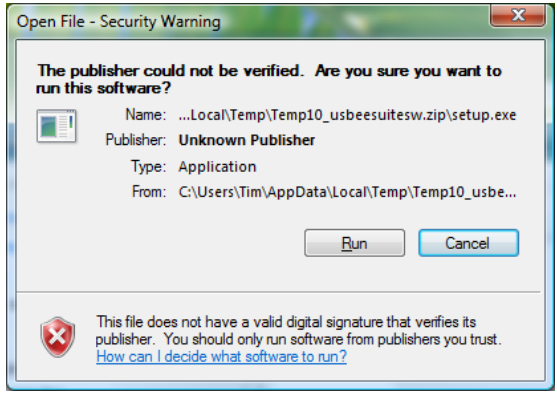
- If you receive messages such as below, press ALLOW or CONTINUE ANYWAY to continue with installation of the software.


Internet Explorer Security
A website wants to open web content using this program on your computer
This program will open outside of Protected mode. Internet Explorer's Protected mode helps protect your computer. If you do not trust this website, do not open this program.
Name: Windows Explorer
Publisher: Microsoft Windows
Do not show me the warning for this program again
Details
Allow
Don't allow

- Run the SETUP.EXE file that is included in the ZIP file that you downloaded to start the installation.

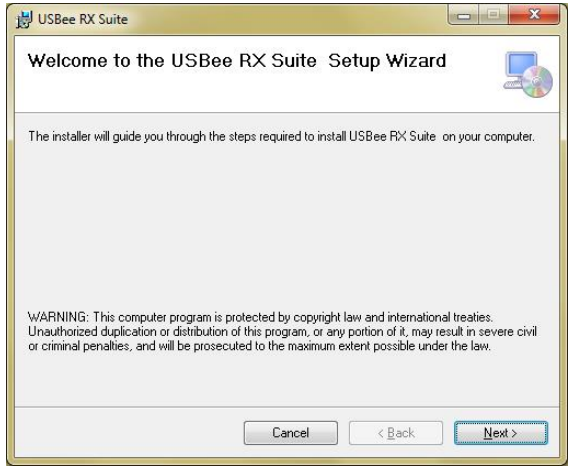


- If you get the following warning, click RUN to continue with the installation.


Open File - Security Warning
The publisher could not be verified. Are you sure you want to run this software?
Name: ...Local\Temp\Temp10_usbeesuitesw.zip\setup.exe
Publisher: Unknown Publisher
Type: Application
From: C:\Users\Tim\AppData\Local\Temp\Temp10_usbe...
Run
Cancel
This file does not have a valid digital signature that verifies its publisher. You should only run software from publishers you trust.
How can I decide what software to run?

- The first part of the installation installs Microsoft requirements, including Microsoft .NET Frameworks Version 4.0. If you do not have this on your PC it will install it for you as shown below – click Accept to install the .NET Frameworks. This installation takes a LONG time, so please be patient since it is worth the wait! If you already have it installed, you will automatically see the "Welcome to the USBee QX Suite Setup Wizard" screen.

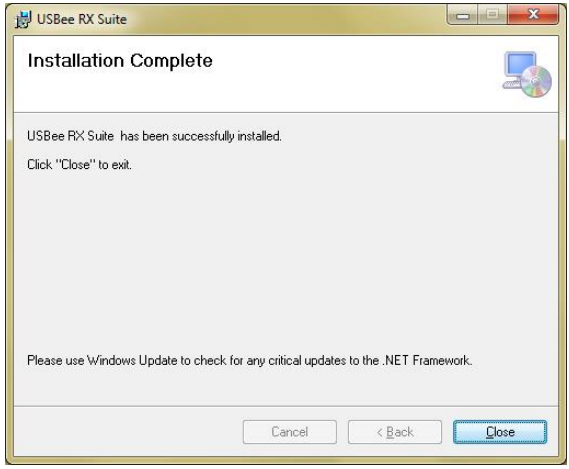
- You will see the Welcome to the USBee QX Suite Setup Wizard screen as shown below


USBee RX Suite
Welcome to the USBee RX Suite Setup Wizard
The installer will guide you through the steps required to install USBee RX Suite on your computer.
WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.
Cancel
< Back
Next >

- During the installation you will see a driver installation dialog box that will install the USBee QX drivers. Click Finish to complete the installation after the drivers have been successfully installed as below.

Device Driver Installation Wizard
Completing the Device Driver Installation Wizard
The device driver installation wizard did not update any of your software for your hardware devices because it was not better than the software you currently have installed.
Driver Name
Status
CWAV, Inc. (WinUSB) ...
Ready to use
< Back
Finish
Cancel

- Follow the instructions (clicking NEXT each time) on the screen to install the USBee QX Suite software on your hard drive. This may take several minutes. When completed you will see the following screen.


USBee RX Suite
Installation Complete
USBee RX Suite has been successfully installed.
Click "Close" to exit.
Please use Windows Update to check for any critical updates to the .NET Framework.
Cancel
< Back
Close

- Click CLOSE and the USBee QX Suite software is now installed.
- To run the USBee QX Suite software, choose the USBee QX Suite icon from the Windows Start Menu or click on the USBee QX icon on the desktop. If no USBee QX is plugged in or installed, you will see the following screen running in Demo Mode (see the top title bar).

- If you have a USBee QX plugged in and installed correctly, you will see a screen with all available channels shown. Below is the USBee QX version showing 16 digital channels and 2 analog channels. You can also see that the device is connect (and not in demo mode) in the top title bar.

DEMO MODE

In the Demo mode, you can see an example trace capture by clicking the Demo button. This loads a trace that includes a number of serial busses and lets you see how the USBee QX Suite can decode the bus traffic, manipulate the waveform data, and use the features of the USBee QX Suite.

The USBee QX Suite display shows the USBee connection status in the title bar of the application. If a USBee QX is connected to the computer when the application starts, the title bar indicates the connection status.

If you run the software with no pod attached, it will run in demonstration mode and simulate data so that you can still see how the software functions.

If you are running in Demo mode and you want to connect to your USBee QX pod, you must exit the USBee QX Suite, connect the USBee QX and then rerun the USBee QX Suite software.

TESTING YOUR CIRCUIT USING THE USBEE QX

In order to quickly get up and running using The USBee QX Suite application, here is a step by step list of the things you need to do to view a waveform trace, after you have installed the software and hardware.

- **Plug in the USBee QX Pod** - Plug the USBee into your computer USB port.
- **Connect Ground** - Connect the GND wire to the Ground of your circuit you would like to test. You can either use the socket to plug onto a header post, or connect it to one of the mini-grabber clips and then attach it to the Ground.
- **Connect Signals** - Connect any of the USBee inputs on the USBee pod to your circuit you would like to test. You can either use the socket to plug onto a header post, or connect it to one of the mini-grabber clips and then attach it to your signal of choice.
- **Run USBee QX Suite** - Run the USBee QX Suite Application from the Start Menu.
- **Press the Capture Once button** - This will capture and display the current activity on all of the signals.
- **View the Waveforms** - You can then scroll the display, either by using the slider bars, or by clicking and dragging on the waveform itself. You can also change the knobs to zoom the waveform.
- **Make Measurements** - You can make simple measurements by using the Cursors area (gray bars under the waves). Click the left mouse button to place one cursor and click the right mouse button to place the second. The resulting measurements are then displayed in the Measurements section of the display.

USING THE USBEE QX SUITE MIXED SIGNAL OSCILLOSCOPE

This section details the operation of the Mixed Signal Oscilloscope, Logic Analyzer and Protocol Analyzer features of the USBee QX Suite application that runs on the USBee QX Test Pod.

When the USBee QX Suite is first run, you will see a screen containing all of the available input signals for the USBee QX Pod plugged into the PC.

The USBee QX Suite maintains its last configuration and will reload that configuration when it is run again. This configuration is located in your \Users\NAME\AppData\Local\USBeeSuite directory where NAME is your username. To reset the software to the initial state you can delete the files in that directory.

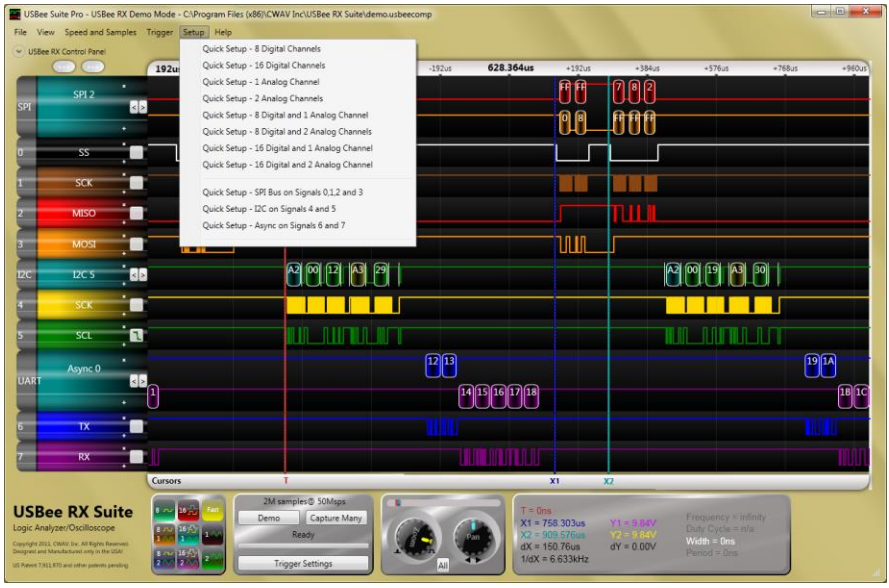
ANALYZER SETUP

QUICK SETUP CONFIGURATION

The USBee QX Suite can capture all of the input channels on the USBee QX. With a QX plugged in, it can capture 24 channels of digital (22 data lines, Clock and Trigger signals) and 4 channels of analog at the same time.

Although you can individually show each signal, there are a number of Quick Configurations that let you instantly select just the channels you need.

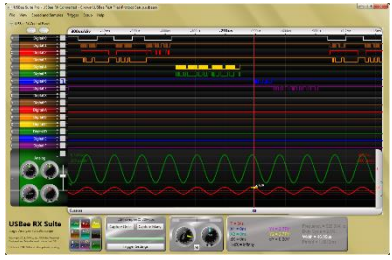
To select a configuration, click **Setup** on the menu and select the Quick Setup configuration of your choice. Below shows the available Quick Setup options for the USBee QX.


USBee Suite Pro - USBee RX Demo Mode - C:\Program Files (x86)\CWAV Inc\USBee RX Suite\demo.usbeecomp
File View Speed and Samples Trigger Setup Help
USBee RX Control Panel
Quick Setup - 8 Digital Channels
Quick Setup - 16 Digital Channels
Quick Setup - 1 Analog Channel
Quick Setup - 2 Analog Channels
Quick Setup - 8 Digital and 1 Analog Channel
Quick Setup - 8 Digital and 2 Analog Channels
Quick Setup - 16 Digital and 1 Analog Channel
Quick Setup - 16 Digital and 2 Analog Channel
Quick Setup - SPI Bus on Signals 0,1,2 and 3
Quick Setup - I2C on Signals 4 and 5
Quick Setup - Async on Signals 6 and 7
628.364us
SPI 2
SS
SCK
MISO
MOSI
I2C 5
SCK
SCL
Async 0
TX
RX
Cursors
USBee RX Suite
Logic Analyzer/Oscilloscope
2M samples@ 50Msps
Demo
Capture Many
Ready
Trigger Settings
Pan
All

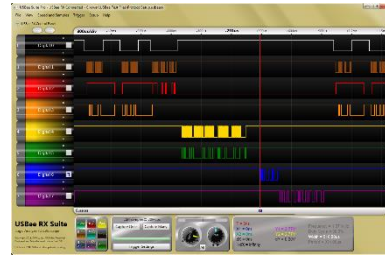
You can also select these modes using the buttons at the bottom of the screen:

The **FAST** button sets the Sample Rate and buffer size to give the fastest screen update rates.

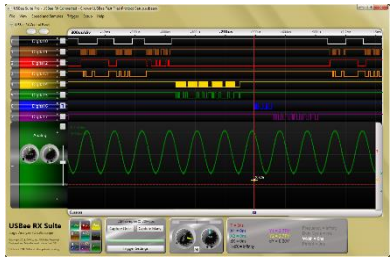
Below are examples of the application in various modes.



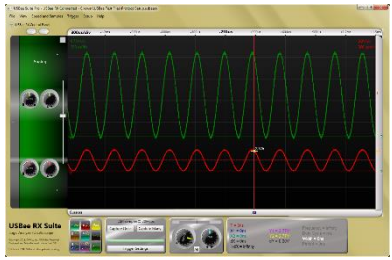
16 Digital–2 Analog Channels



8 Digital–0 Analog Channels



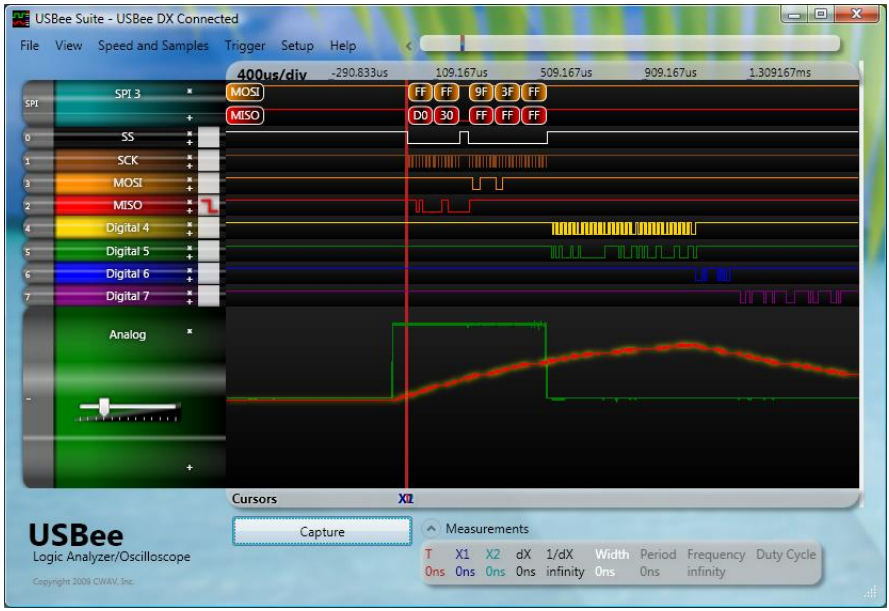
8 Digital–1 Analog Channels



0 Digital–2 Analog Channels

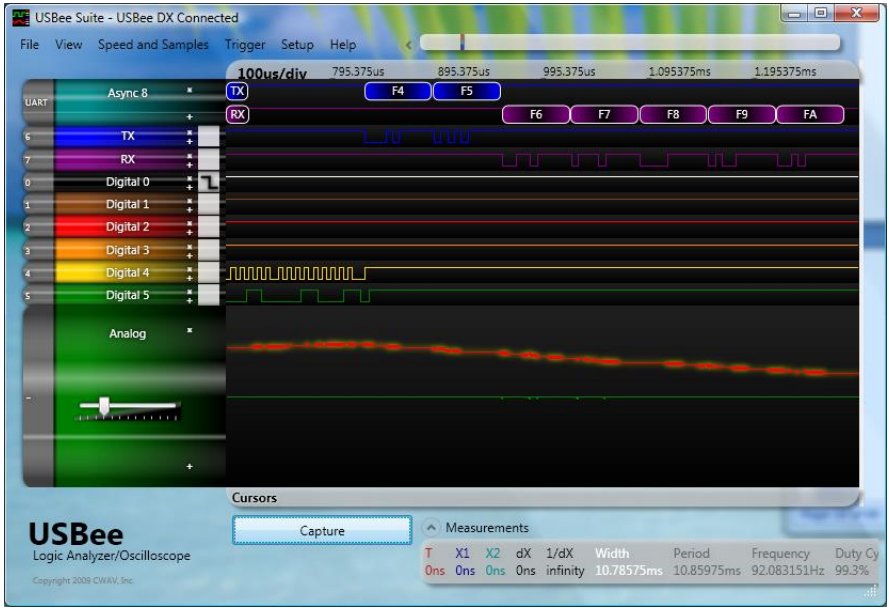
There are also three other Quick Setup features that let you instantly setup an I2C, SPI or ASYNC decoder line.

The **Quick Setup – SPI** configures the first 4 lines to be an SPI bus with the SS, SCK, MOSI and MISO lines. It also adds a decoder line to the screen with this data decoded as below.



The **Quick Setup – I2C** configures the signals 4 and 5 to be an I2C bus with the SDA and SCL lines. It also adds a decoder line to the screen with this data decoded as below.

The **Quick Setup – ASYNC** configures the signals 6 and 7 to be a full duplex ASYNC bus with the TX and QX lines. You will need to change the baud rate, data bits and parity to match your bus. It also adds a decoder line to the screen with this data decoded as below.



HOT KEYS

The USBee QX has a full set of hot keys that lets you drive the acquisition of samples, setup configuration and quickly view your data using the keyboard.

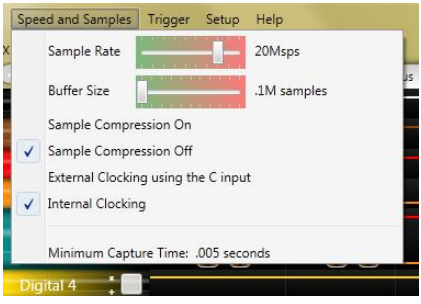
Key	Function
Left Arrow	Previous Edge/Packet
Right Arrow	Next Edge/Packet
Shift-Left Arrow	Pan Left
Shift-Right Arrow	Pan Right
Up Arrow	Previous Waveline
Down Arrow	Next Waveline
Home	Show the Start of capture buffer
End	Show the end of the capture buffer
Ins	Insert a new waveline below the current line
Del	Delete the current waveline
Space	Capture Once
1	Go to the X1 cursor
2	Go to the X2 cursor
A	Zoom out to view all of the capture buffer
B	Open the Waveline settings dialog box
D	Toggle the Decoder List window
I	Zoom In
O	Zoom Out
T	Go to the Trigger position

SIGNAL NAMES

To change the names shown for a signal, click on the signal name and enter a new name.

BUFFER SIZES AND SAMPLE RATE SETTINGS

The USBEE QX SUITE captures the behavior of the digital and analog signals and displays them as “traces” in the waveform window. The Speed and Samples menu lets you choose how the traces are captured. Below shows the Speed and Samples menu.



The **Buffer Size** lets you select the size of the Sample Buffer that is used. For each trace, the buffer is completely filled, and then the waveform is displayed. You can choose buffers that will capture the information that you want to see, but remember that the larger the buffer, the longer it will take to fill, display and decode.

You can also choose the **Sample Rate** that you want samples taken. You can choose from 100ksps (samples per second) to up to 600 Msps. At up to 100Msps all channels can be sampled. At higher sample rates, a subset of channels is available. The table below shows how many channels are available for the given sample rates.

Available Channels and resulting Sample Rate for each channel				
Sample Rate Setting in sps	< = 100M (1)	200M (2)	300M (3)	600M (6)
CH4	1	1	1	1
CH3	1	1	1	1
CH2	1	1	1	1
CH1	1	1	1	1
0	1	2	3	6
1	1	2	3	6
2	1	2	3	1
3	1	2	3	1
4	1	2	3	1
5	1	2	1	1
6	1	2	x	x
7	1	2	x	x
8	1	x	x	x
9	1	x	x	x
10	1	x	x	x
11	1	x	x	x
12	1	x	x	x
13	1	x	x	x
14	1	x	x	x
15	1	x	x	x
16	1	1	1	1
17	1	1	1	1
18	1	1	1	1
19	1	1	1	1
20	1	1	1	1
21	1	1	1	1
T	1	1	1	1
C	1	1	1	1

The USBee QX can use sample compression to lengthen the capture time. In **Sample Compression** mode, only the transitions are stored, effectively removing the samples between inactivity. To turn on Sample Compression, select Sample Compression On in the Speed and Samples menu.

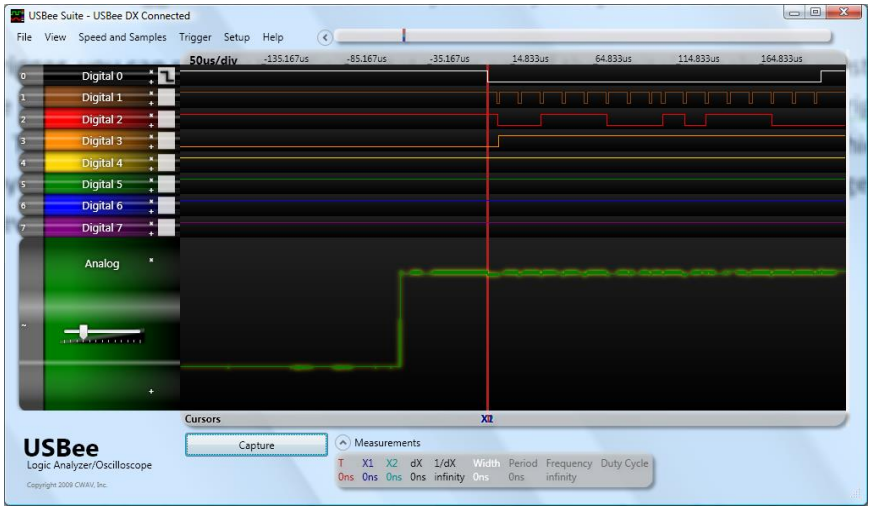
The Sample Compression works on just the channels that are shown on the screen, so for the longest trace buffers, only display the signals that you are interested in. All other channels will be masked out and not captured.

You can also use an external clock (using the C input) to gather each sample instead of the internal sample clock. To turn on **External Clocking**, select External Clocking using the C Input on the Speed and Samples menu. The external clock can run up to 100MHz. When external Clocking is enabled, Sample Compression is not available.

SETTING SIMPLE TRIGGERS

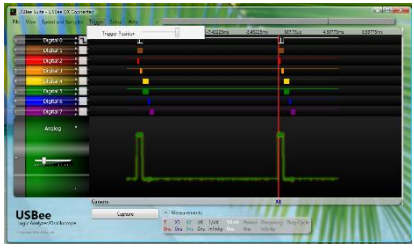
The USBee QX Suite uses a Trigger mechanism to allow you to capture just the data that you want to see.

For a **Digital trigger**, you can specify the digital states for any of the digital signals that must be present on the digital lines before it will trigger. Below shows the trigger settings (to the right of the Signal labels). This example shows that we want to trigger on a falling edge of Signal 0, which is represented by a high level followed by a low level. To change the level of any of the trigger settings, just click the level button to change from don't care to rising edge to falling edge.

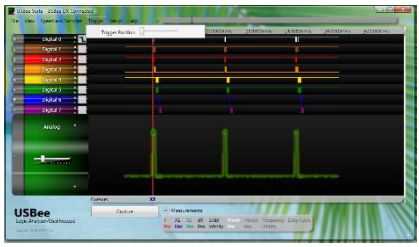


The waveforms are shown with a trigger position which represents where the trigger occurred. This sample point is marked on the waveform display with a Vertical red cursor line and a "T" in the horizontal cursors bar.

You can use the **Trigger Position** menu setting to specify how much of the data that is in the sample buffer comes before the actual trigger position. If you place the Trigger Position all the way to the left, most of the samples taken will be after the trigger sample. If you place Trigger Position all the way to the right, most of the samples taken will be before the Trigger sample. This control lets you see what actually happened way before or way after the trigger occurred.



Trigger Position to the Right

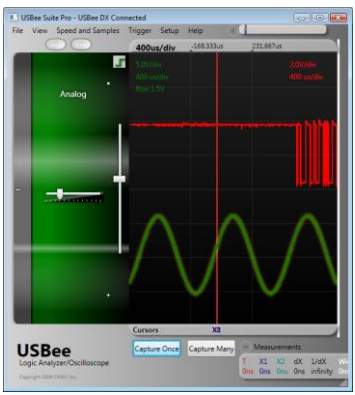


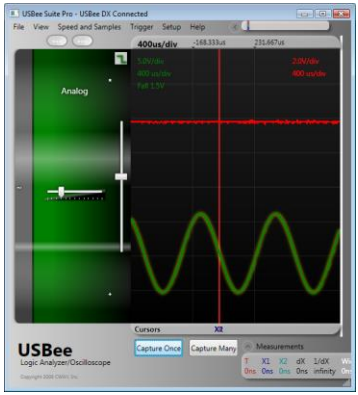
Trigger Position to the Left

For an **Analog trigger** you must specify the Channel to use, Rising or Falling Edge, and the Trigger Level. Click on the Trigger Settings Box (to the right of the waveline delete "X") repeatedly to toggle through Channel 1 Rising, Channel 1 Falling, Channel 2 Rising, Channel 2 Falling, etc, and None. You then specify the trigger voltage level (-6V to +6V) by using the vertical slider on the left hand side of the analog waveform display. The trigger level edge and value will be shown as you scroll this level underneath the Volts/Div and Secs/Div labels within the waveform area.

For an analog trigger, the trigger position is where the waveform crossed the **Trigger Voltage** level that you have set at the specified slope. To move the trigger voltage level, just move the slider on the left of the waveform.

The following figures show a trace captured on each of the edges.



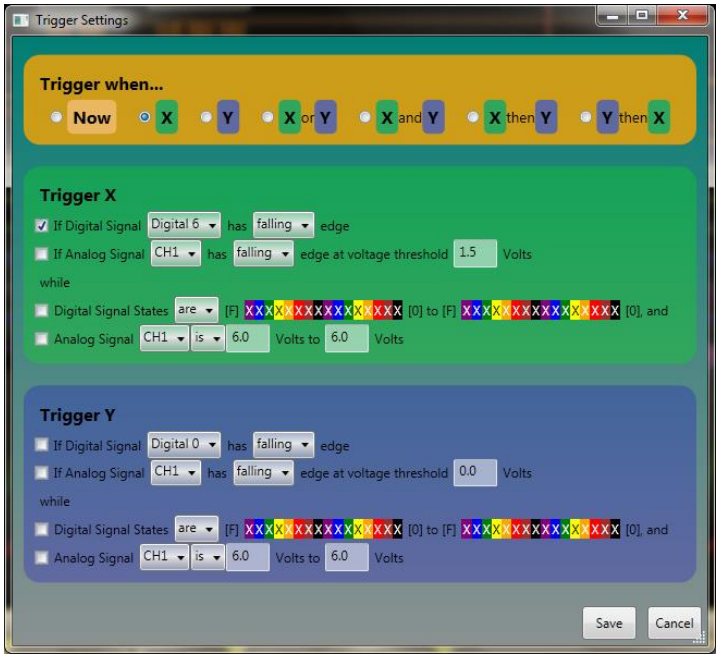


Analog Trigger Slope = Rising Edge Analog Trigger Slope = Falling Edge

The Trigger position is placed where the actual signal crosses the trigger voltage with the proper slope. The USBee pods allow for huge sample buffers, which means that you can capture much more data than can be shown on a single screen. Therefore you can scroll the waveform back and forth on the display to see what happened before or after the trigger.

SETTING COMPLEX TRIGGERS

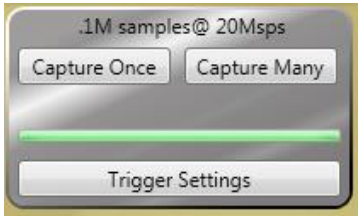
The USBee QX Suite also allows you to set more complex triggers using the Triggers Dialog box as shown below.



There are two levels of triggers available, X and Y. Each trigger event (X or Y) can have any combination of analog or digital edges which can be qualified using digital patterns or analog voltage levels.

CAPTURING WAVEFORM DATA

Press the Capture buttons to start capturing the waveform data from your hardware design. If you are running in Demo mode, the button reads Demo. Capture Once performs a single capture, while Capture Many repeatedly captures and displays consecutive traces.

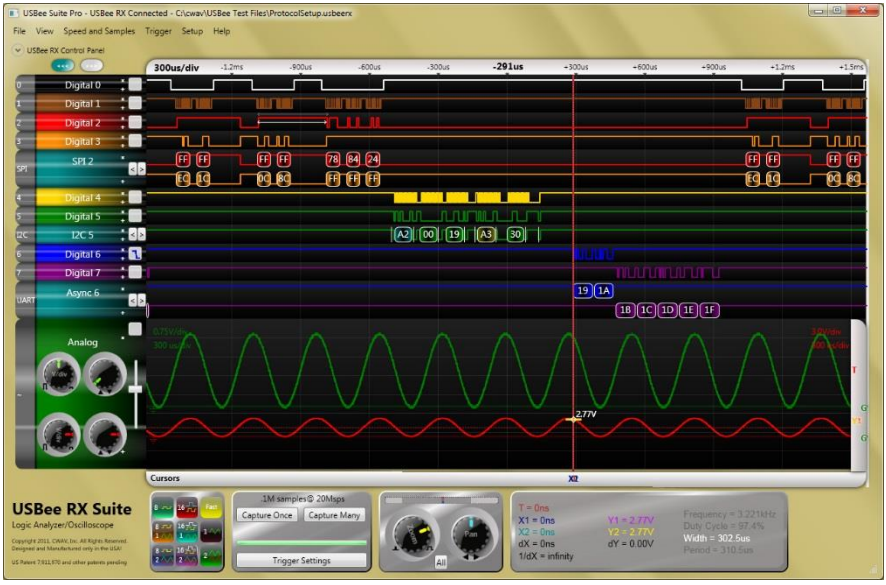


Each capture will look for the trigger condition, fill the buffer with samples of the signals and stop. If you would like to stop the capture before it is completed just press the same button again (which reads STOP during a capture). After a trace is captured, the waveform data is gathered, decoded (if needed) and displayed in the waveform window.

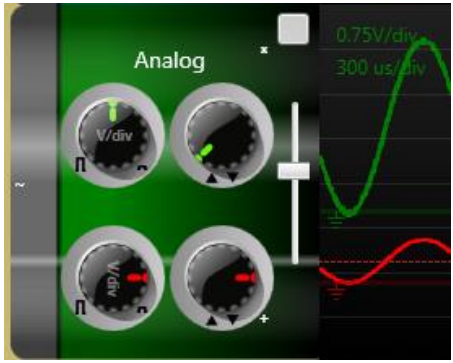
VIEWING CAPTURED DATA

SCROLLING, ZOOMING AND PANNING WAVEFORMS

The Waveform display area is where the measured signal information is shown. It is displayed with time increasing from left to right and voltage increasing from bottom to top.



The position of the waveform defaults to show the actual trigger position in the center of the screen after a capture. However, you can move the display to see what happened before or after the trigger position.



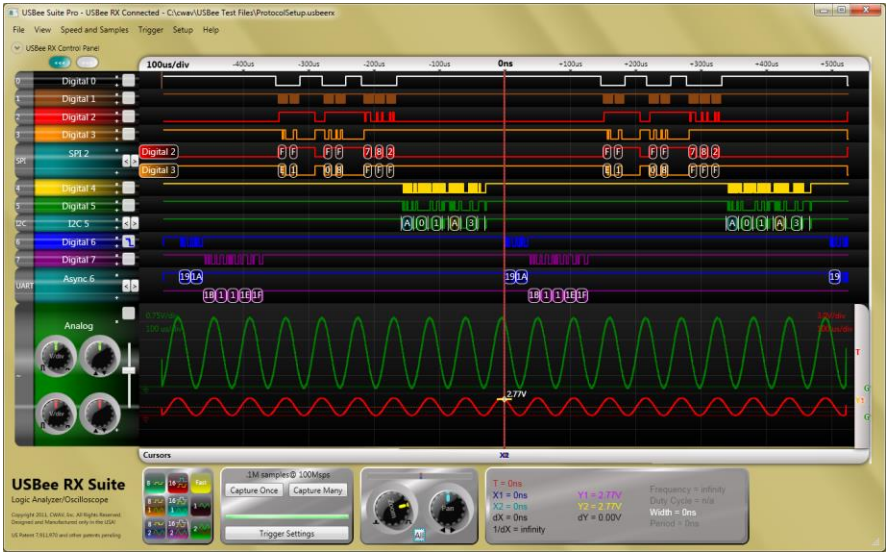
To **Scroll the Waveforms in Time** left and right, you can click on the overview bar above the knobs, scroll the **Pan knob** (click and drag or mouse wheel on the knob) or you can simply click and drag the waveform itself with the left mouse button.

To **Scroll the Analog Waveform in Voltage** up and down, you can simply click and drag the waveform itself by selecting and dragging using the mouse or use the **analog offset knob** to the left of the analog waveforms.

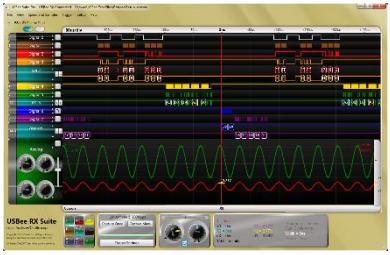
To **Zoom In** or **Zoom Out**, or otherwise change the number of **Seconds per Division,** you can use the scroll wheel or single click on the waveform. You can also use the **Zoom knob** (click and drag or mouse wheel on the knob). To zoom in, scroll up or click the left mouse on the waveform window. To zoom out in time, scroll down or click the right mouse button on the waveform window.

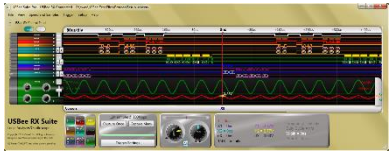
To change the number of **Volts per Division** for an analog channel, use the **V/div knob** (click and drag or mouse wheel on the knob) highlight the channel you want to change, or you can hold the left mouse button down and use the scroll wheel. You can also highlight the signal and use the slider bar to the left of the waveform.

To view the entire capture buffer on the display, press the **All** button. The screen below shows all of the collected samples on a single screen for that trace.



To **Stretch and Shrink** the display, you can click and drag the edges of the application to the size you want. All waves will scale to fit. Below you see two examples of different size displays.





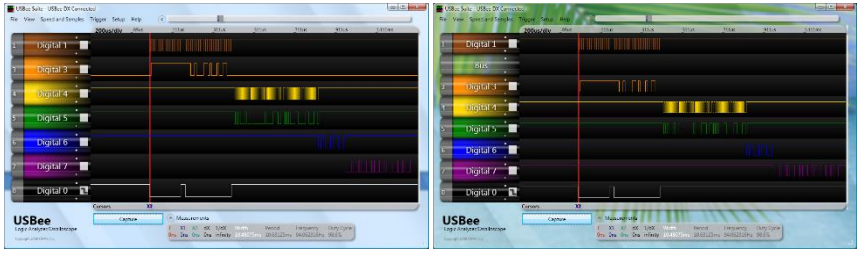
MODIFYING WAVE LINES

Each line on the display is called a **Waveline**. Wavelines can be modified to your liking so that you see the data you need to solve your problem. You can delete, add, move, or reconfigure any waveline.

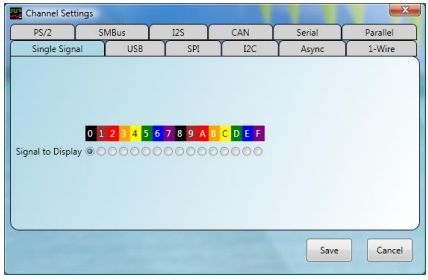
To **Delete a Waveline** from the screen, press the little X near the signal name. This will remove the waveline from the screen. Below shows the USBee QX Suite after deleting the Digital 2 waveline.

To **Move a Waveline**, simply click on the gray tab on the left and drag it to the new position. Below shows the Digital 0 signal moved to the bottom.

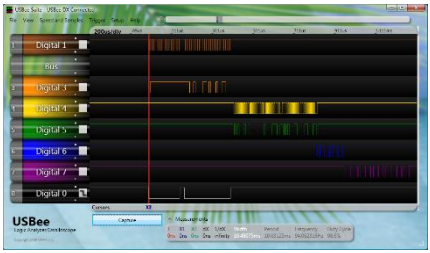
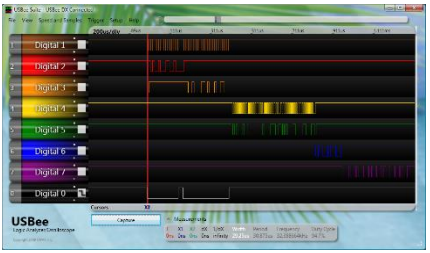
To Add a Waveline, click on the small + sign above where you want to insert the new waveline. Below you see a new waveline inserted after the first waveline.



When you insert a new waveline the Channel Selection dialog box appears for you to choose the settings for that waveline. Below shows the Channel Settings Dialog Box.

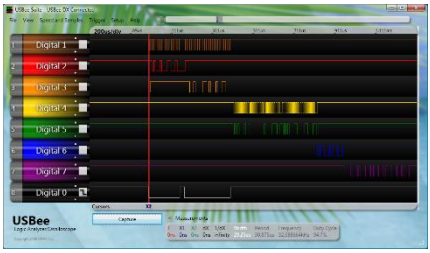
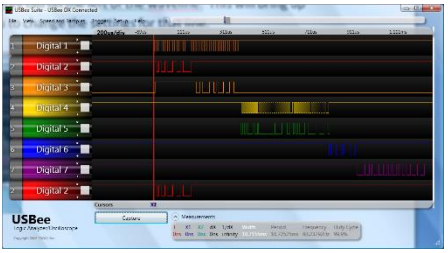


Once you select the properties of the new waveline, it will be displayed with the other signals. Below shows a new line added that shows the Digital 2 single signal.

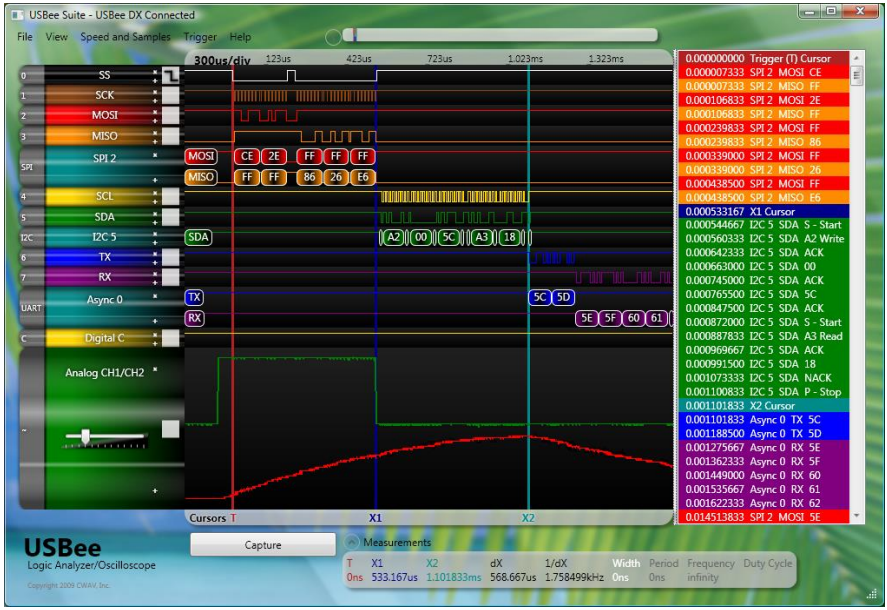
We will go through creating Bus wavelines that decode bus traffic in-line in the next section.

To **Modify an Existing Waveline** click on the grey tab on the left of the waveline. This will bring up the Channel Settings dialog box and allow you to change the settings for that line. Below we modified the last line to show Digital 2 signal instead of the Digital 0 signal.

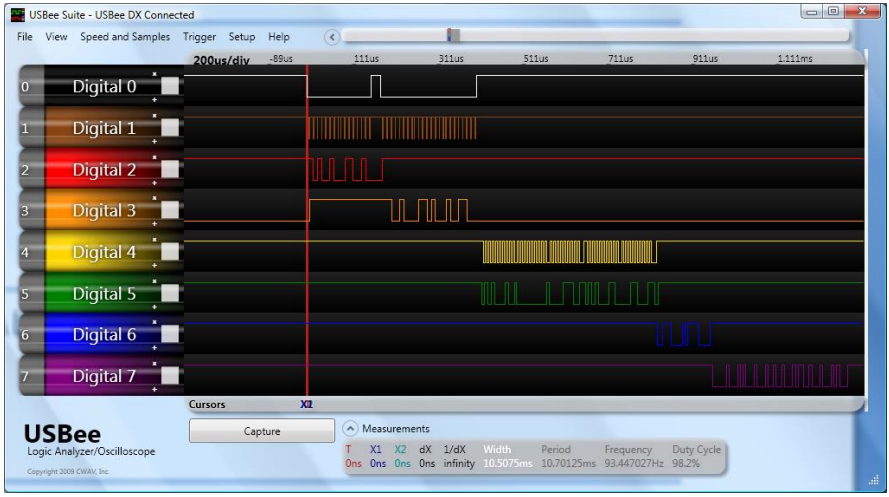



DECODING BUS TRAFFIC INLINE

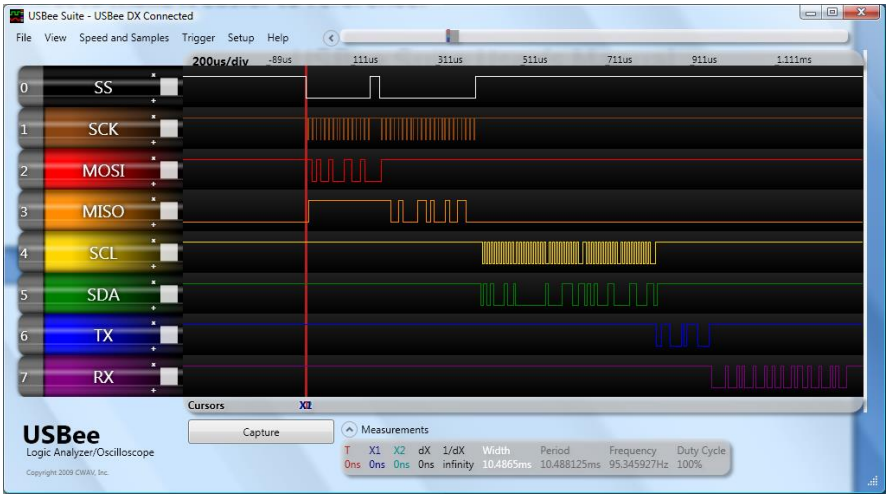
The USBee QX Suite software can decode certain types of serial busses automatically and display that information in-line with the waveforms. Below is an example of a screen that shows 3 different serial bus decoders at the same time, one SPI, one I2C, and one full duplex ASYNC channel.



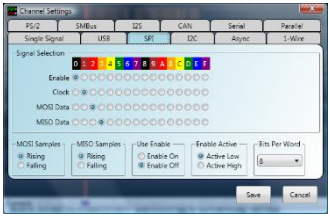
We will go through an example that shows how to setup various busses. We start with a capture of 8 digital lines that have a number of busses included.

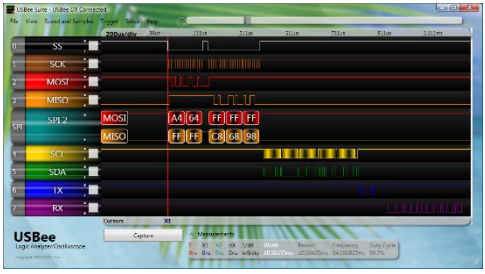


In this example, we will name the bus signals first to make it easier to reference.



Now we will add an SPI bus which is made up of the first 4 signals. We press the small + sign near the MISO label to insert the waveline below that line. We then get the Channel Settings Dialog and choose the SPI tab. The following screen is then displayed.

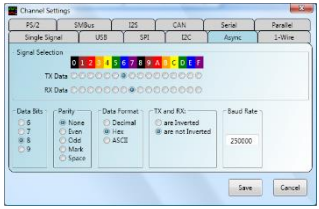




From here we select the parameters for this bus (shown above) and press Save. Once we press Save, the line is added to the screen, the current trace is decoded, and the decoded information is shown on the waveline.

We then add the I2C bus using the Channel Settings dialog box as below with the resulting waveline.

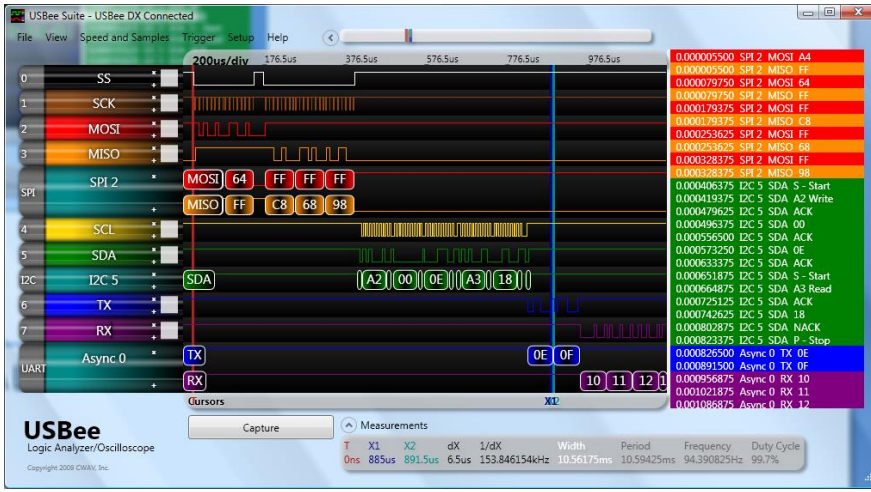
We then add the Async bus using the Channel Settings dialog box as below with the resulting waveline.



Each bus type has various parameters that can be tailored to get the data out of your bus the way you need it.

DECODED DATA LIST

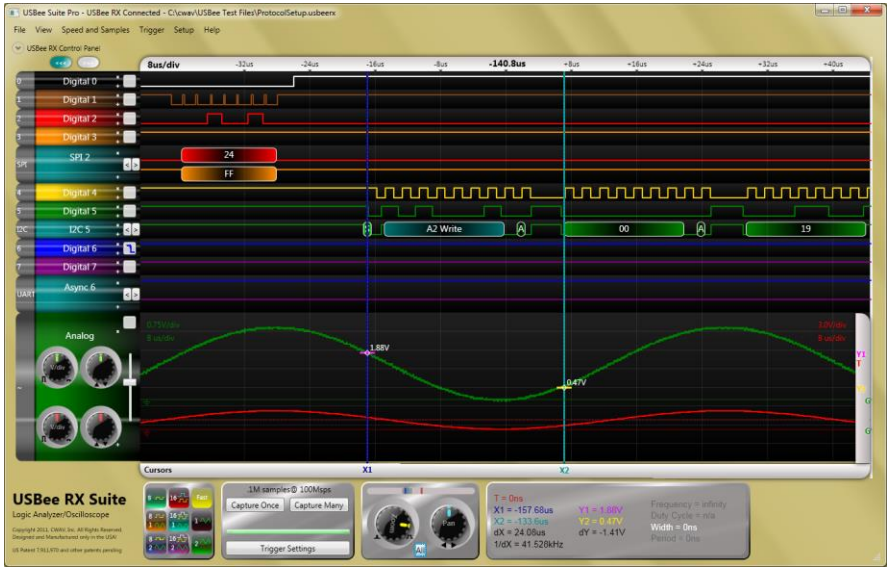
You can see the decoded list data in vertical format using the View/Show Decode Bus Listing menu item. This opens a window on the right side of the screen that displays the decoded data in vertical format. The data shown is the data that is decoded from the left side of the waveform screen. This data is synchronized to the waveforms as you pan and zoom.



You can hide or change the width of the Decoded Bus Listing window by clicking and dragging the vertical line to the left of the window.

MANUAL MEASUREMENTS AND CURSORS

The main reason for using an oscilloscope or logic analyzer is to measure the various parts of a waveform. The USBee QX Suite uses cursors to help in these measurements.



The **X1 and X2 Cursors** are placed on any horizontal sample time. This lets you measure the time at a specific location or the time between the two cursors. To place the X cursors, move the mouse to the gray Cursors box just below the waveform. When you move the mouse in this window, you will see a temporary line that indicates where the cursors will be placed. Place the X1 cursor by left clicking the mouse at the current location. Place the X2 cursor by right clicking the mouse at the current location. These cursors will snap to the exact edge of a digital signal when the mouse moves close to the edge. This lets you easily get exact measurements between edges of signals.

In the Measurement window, you will see the various measurements made off of these cursors.

- **X1 Position** – time at the X1 cursor relative to the trigger position
- **X2 Position** – time at the X2 cursor relative to the trigger position
- **QX** – time difference between X1 and X2 cursors
- **1/QX** – the frequency computed using the period between X1 and X2 cursors

INSTA-MEASUREMENTS

The Insta-Measure feature lets you quickly and accurately measure events and levels by simply hovering the mouse over a signal and without placing cursors.

Inta-Measurements available are as follows:

Analog Insta-Measurements

- Voltage At Cursor

Digital Insta-Measurements

- Width, Period, Frequency and Duty Cycle

BUS DECODING OPTIONS

The USBee QX Suite software has a powerful embedded bus decoder feature that allows you to quickly analyze the contents of embedded communications captured by the pod. This section details each of the available bus types and the parameters required for proper setup.

GENERIC SIGNAL SETUP

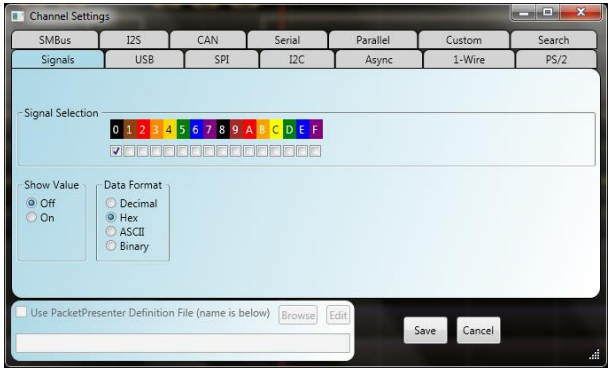
The default trace shown on a waveline is a voltage versus time waveform representation of an input wire on the USBee QX.

Hardware Setup

To use the generic signal display you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

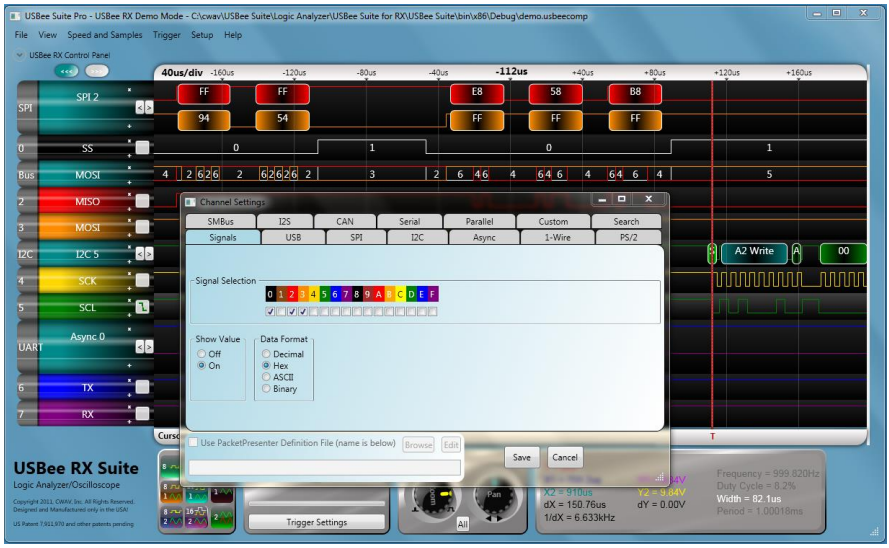
Software Setup

Activate the below Channel Settings Dialog by clicking the grey tab on the left of the signal names on the main application screen.



On the above dialog box, select the signals you want to display by checking the associated check box, choose whether to show the value of the selected signals and what format you would like the values.

The signal traffic will be shown as in the following screen. The SS line shows a single signal with the values turned on. The MOSI line shows a combination of three different signals and the resulting value of those signals. The associated settings dialog box is shown.


USBee Suite Pro - USBee RX Demo Mode - C:\cwav\USBee Suite\Logic Analyzer\USBee Suite for RX\USBee Suite\bin\x86\Debug\demo.usbeecomp
File View Speed and Samples Trigger Setup Help
USBee RX Control Panel
40us/div
-112us
SPI 2
SS
MOSI
MISO
MOSI
I2C 5
SCK
SCL
Async 0
TX
RX
Channel Settings
SMBus I2S CAN Serial Parallel Custom Search
Signals USB SPI I2C Async 1-Wire PS/2
Signal Selection
Show Value
Off
On
Data Format
Decimal
Hex
ASCII
Binary
Use PacketPresenter Definition File (name is below)
Browse
Edit
Save
Cancel
A2 Write
00
USBee RX Suite
Logic Analyzer/Oscilloscope
Trigger Settings
Pan
All
X2 = 910us
dX = 150.76us
1/dX = 6.633kHz
dY = 0.00V
Frequency = 999.820Hz
Duty Cycle = 8.2%
Width = 82.1us
Period = 1.00018ms

CAN BUS SETUP

The CAN Bus Decoder takes the captured data from a CAN bus (11 or 29-bit identifier supported), formats it and allows you to save the data to disk or export it to another application using Cut and Paste.

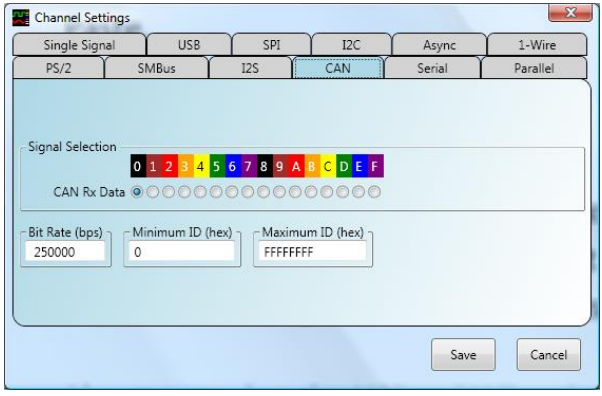
Hardware Setup

To use the Decoder you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

The CAN Bus Decoder connects to the digital side of your CAN bus transceiver and only needs to listen to the receiving side of the transceiver (such as the QXD pin on the Microchip MCP2551 CAN bus transceiver chip). Use signal 0 as the QXD data line and connect the GND line to the digital ground of your system. Connect these signals to the CAN bus transceiver IC using the test clips provided.

Software Setup

Activate the below Channel Settings Dialog by clicking the grey tab on the left of the signal names on the main application screen.



On the above dialog box, select the CAN data signal, what speed the bus is operating at and what filter value for the ID you want (if any)

The bus traffic will be decoded as in the following screen.

USB BUS SETUP

The USB Bus Decoder decodes Low and Full Speed USB. It does NOT decode High Speed USB

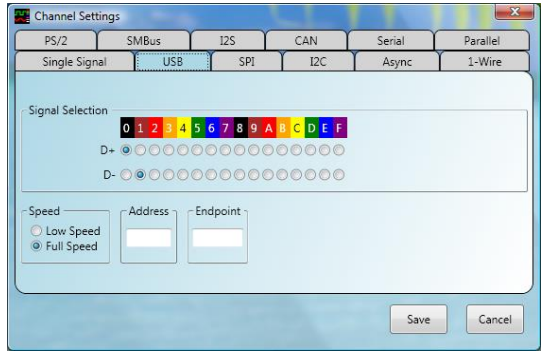
Hardware Setup

To use the Decoder you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

Connect two of the digital signals to the D+ and D- of your embedded USB bus, preferably at the IC of the USB device or the connector that the USB cable plugs into.

Software Setup

Activate the below Channel Settings Dialog by clicking the grey tab on the left of the signal names on the main application screen.



On the above dialog box, select the D+ and D- signals and what speed the bus is operating at. You can also specify a specific USB Address or Endpoint you want to see. All other transactions will be filtered out. Leave the fields blank to see all transactions.

The bus traffic will be decoded as in the following screen.

I2C BUS SETUP

The I2C Bus Decoder takes the captured data from an I2C bus.

Hardware Setup

To use the Decoder you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

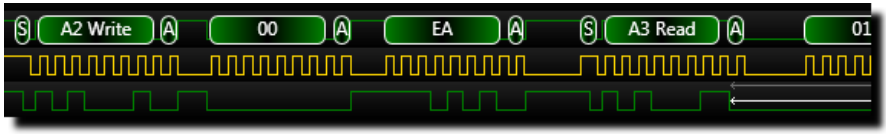
The I^2C Bus Decoder connects to the SDA and SCL lines of the I^2C bus. Use one signal as the SDA data line and one signal as the SCL clock line. Also connect the GND line to the digital ground of your system. Connect these signals to the I^2C bus using the test clips provided.

Software Setup

Activate the below Channel Settings Dialog by clicking the grey tab on the left of the signal names on the main application screen.

On the above dialog box, select the SDA and SCL signals.

The bus traffic will be decoded as in the following screen.



ASYNC BUS SETUP

The Async Bus Decoder takes the captured data from an asynchronous bus (UART).

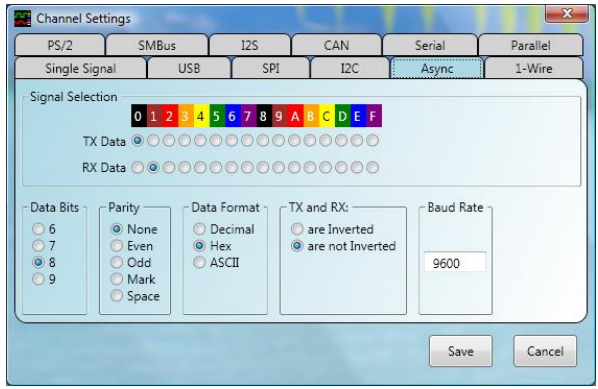
Hardware Setup

To use the Decoder you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

The Async Bus Data decoder uses one or more of the 24 digital signal lines (0 thru 21 + T and C) and the GND (ground) line. Connect any of the 24 signal lines to an Async data bus. Connect the GND line to the digital ground of your system.

Software Setup

Activate the below Channel Settings Dialog by clicking the grey tab on the left of the signal names on the main application screen.



On the above dialog box, select the channels you want to observe. Each channel can be attached to a different async channel. Also enter the baud rate (from 1 to 24000000), the number of data and parity bits, and what output format you want the traffic.

PARALLEL BUS SETUP

The Parallel Bus Decoder takes the captured data from a parallel bus. The Parallel Bus decoder is also a way to capture the data using an external clock.

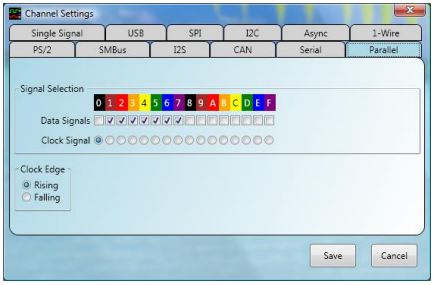
Hardware Setup

To use the Decoder you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

The Parallel Bus Data decoder uses the 24 digital signal lines (0 thru 21 + T and C), the GND (ground) line. Connect the GND line to the digital ground of your system.

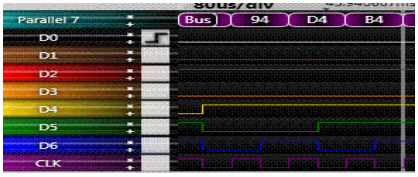
Software Setup

Activate the below Channel Settings Dialog by clicking the white box on the left of the signal names on the main application screen.



On the above dialog box, select the channels you want to include in the parallel data bus. You can also use any one of the 16 digital signals as an external clock. Choose if you want to use the external clock signal and the external clock edge polarity.

The bus traffic will be decoded as in the following screen.



1-WIRE BUS SETUP

The 1-Wire Bus Decoder takes the captured data from a 1-Wire bus.

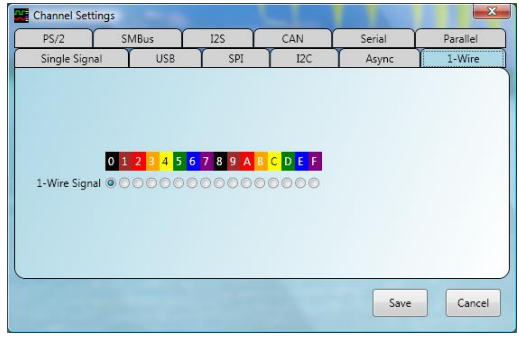
Hardware Setup

To use the Decoder you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

The 1-Wire Bus Data decoder uses any one of the 24 digital signal lines (0 thru 21 + T and C), the GND (ground) line. Connect the GND line to the digital ground of your system.

Software Setup

Activate the below Channel Settings Dialog by clicking the grey tab on the left of the signal names on the main application screen.



On the above dialog box, select the signal running your 1-Wire protocol.

SPI BUS SETUP

The SPI Bus Decoder takes the captured data from an SPI bus.

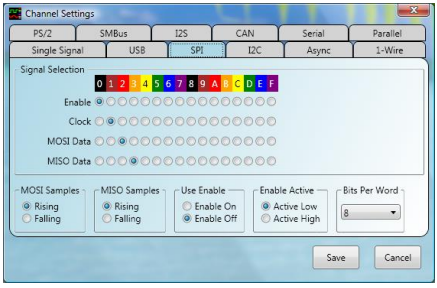
Hardware Setup

To use the Decoder you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

The SPI Bus Decoder uses any one of the 24 digital signal lines (0 thru 21 + T and C) for the SS (slave select), SCK (clock), MISO (data in), MOSI (data out), and the GND (ground) line. Connect the SS, SCK, MISO, and MOSI to your digital bus using the test leads and clips. Connect the GND line to the digital ground of your system.

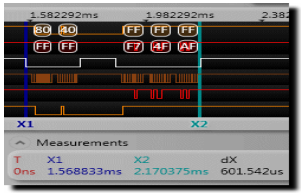
Software Setup

Activate the below Channel Settings Dialog by clicking the grey tab on the left of the signal names on the main application screen.



On the above dialog box, select the signals you plan to use for the SPI protocol. Also set the appropriate sampling edges for both data lines and if you would like to use the SS (slave select) signal. If you turn off the SS, all clocks are considered valid data bits starting at the first clock detected. Also choose what output format you want the traffic.

The bus traffic will be decoded as in the following screen.



SDIO BUS SETUP

The SDIO Bus Decoder shows the captured data from an SDIO bus Command and Data lines.

Hardware Setup

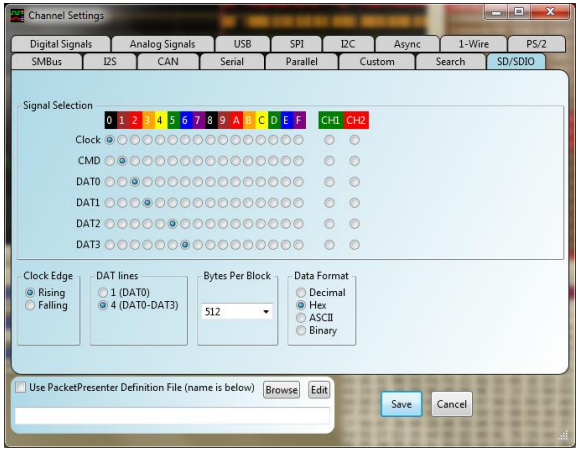
To use the Decoder you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

The SDIO Bus Decoder uses any one of the 24 digital signal lines (0 thru 21 + T and C) for the CMD (command), CLK (clock), DAT0, DAT1, DAT2, DAT3 and the GND (ground) line. Connect the CMD, CLK and DAT0-DAT3 lines to your digital bus using the test leads and clips. Connect the GND line to the digital ground of your system.

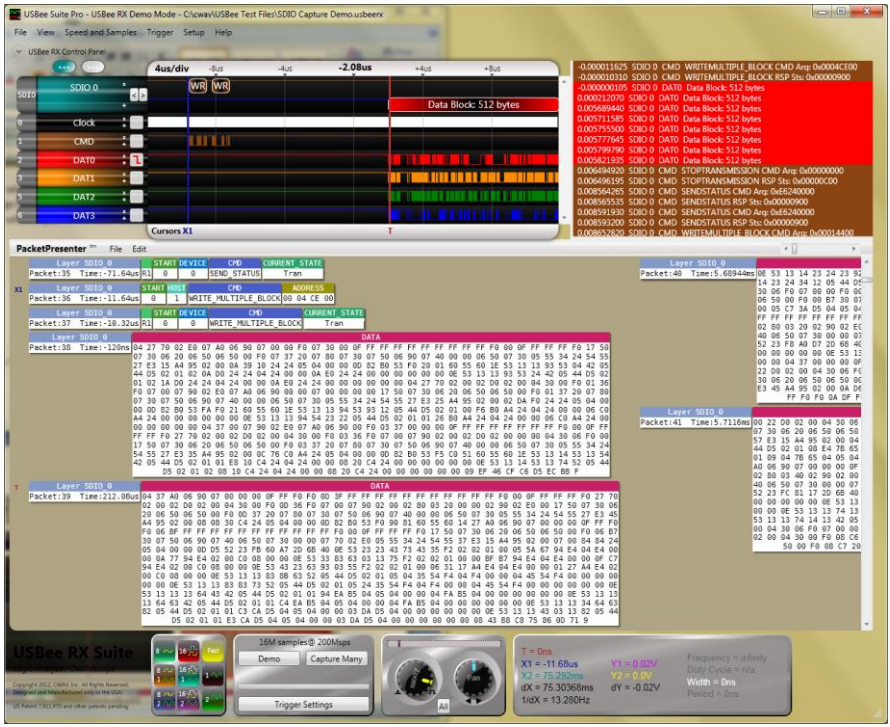
Software Setup

You will want to make sure that the sample rate you have chosen is at least 4 times the CLK frequency in order to recover the bus data reliably. So, for a CLK with a frequency of 50MHz, you need at least a sample rate of 200Msps. Also remember that at sample rates above 100Msps the available channels is reduced.

Activate the below Channel Settings Dialog by clicking the grey tab on the left of the signal names on the main application screen.



On the above dialog box, select the signals you plan to use for the SDIO protocol. Also set the appropriate sampling edge for the CMD and DAT lines, how many DAT lines to use and the size of the data blocks. Also choose the output format for the traffic.


USBee Suite Pro - USBee RX Demo Mode - C:\cwav\USBee Test Files\SDIO Capture Demo.usbeerx
File View Speed and Samples Trigger Setup Help
USBee RX Control Panel
4us/div
-2.08us
SDIO 0
Clock
CMD
DAT0
DAT1
DAT2
DAT3
Data Block: 512 bytes
Cursors X1
PacketPresenter™
File Edit
Layer SDIO 0
START DEVICE CMD CURRENT_STATE
SEND_STATUS Tran
START HOST CMD ADDRESS
WRITE_MULTIPLE_BLOCK 00 04 CE 00
START DEVICE CMD CURRENT_STATE
WRITE_MULTIPLE_BLOCK Tran
DATA
USBee RX Suite
16M samples@ 200Msps
Demo
Capture Many
Trigger Settings
T = 0ns
X1 = -11.68us
X2 = 75.292ms
dX = 75.30368ms
1/dX = 13.280Hz
Y1 = 0.02V
Y2 = 0.0V
dY = -0.02V
Frequency = infinity
Duty Cycle = n/a
Width = 0ns
Period = 0ns

SM BUS BUS SETUP

The SM Bus Decoder takes the captured data from an SM bus.

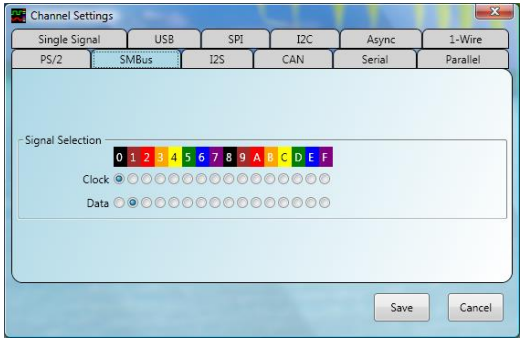
Hardware Setup

To use the Decoder you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

The SM Bus Decoder uses any one of the 24 digital signal lines (0 thru 21 + T and C) for the SM Clock and SM Data, and the GND (ground) line. Connect the SM Clock and SM Data to your digital bus using the test leads and clips. Connect the GND line to the digital ground of your system.

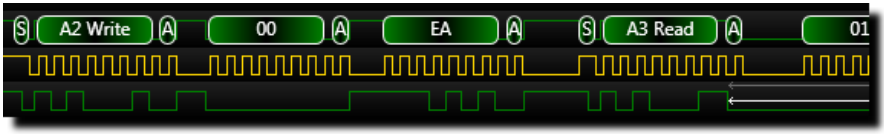
Software Setup

Activate the below Channel Settings Dialog by clicking the white box on the left of the signal names on the main application screen.



On the above dialog box, select the signals you plan to use for the SM Bus protocol.

The bus traffic will be decoded as in the following screen.



SERIAL BUS SETUP

The Serial Bus Decoder takes the captured data from a Serial bus. The serial data can be from any clocked serial bus and can be aligned using a hardware signal or an embedded sync word.

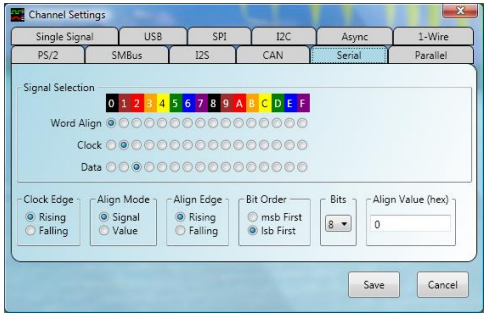
Hardware Setup

To use the Decoder you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

The Serial Bus Decoder uses any one of the 24 digital signal lines (0 thru 21 + T and C) for the Clock, Data and optional Word Align signal, and the GND (ground) line. Connect the Clock, Data and Word Align to your digital bus using the test leads and clips. Connect the GND line to the digital ground of your system.

Software Setup

Activate the below Channel Settings Dialog by clicking the white box on the left of the signal names on the main application screen.



On the above dialog box, select the signals you plan to use for the Serial Bus protocol. Select whether you have an external word align signal (Align Mode = Signal) or if your serial data has an embedded sync word in the data stream (Align Mode = Value). The Bits/Word is the size of the Sync word as well as the output word size. Choose the bit ordering as well as the output format of the traffic.

The bus traffic will be decoded as in the following screen.

I2S BUS SETUP

The I2S Bus Decoder takes the captured data from an I2S bus.

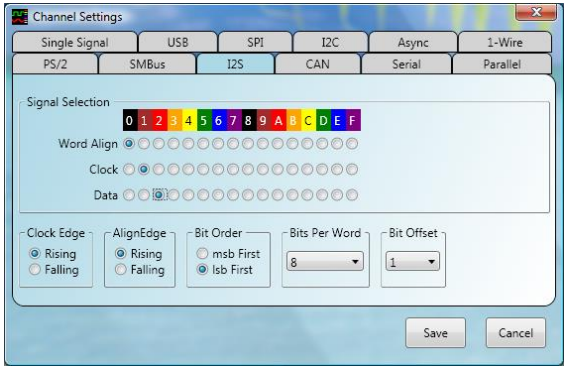
Hardware Setup

To use the Decoder you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

The I2S Bus Decoder uses any one of the 24 digital signal lines (0 thru 21 + T and C) for the Clock, Data and Word Align signal, and the GND (ground) line. Connect the Clock, Data and Word Align to your digital bus using the test leads and clips. Connect the GND line to the digital ground of your system.

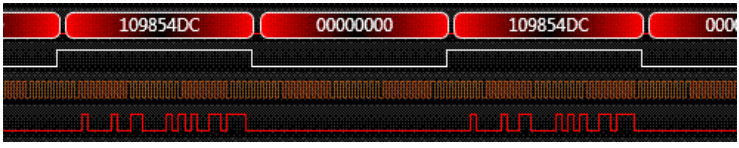
Software Setup

Activate the below Channel Settings Dialog by clicking the grey tab on the left of the signal names on the main application screen.



On the above dialog box, select the signals you plan to use for the I2S Bus protocol. Select the start edge for the external word align signal, the Bits/Word and the Clock sampling edge. Choose the bit ordering.

The bus traffic will be decoded as in the following screen.



PS/2 BUS SETUP

The PS/2 Bus Decoder takes the captured data from a PS/2 bus.

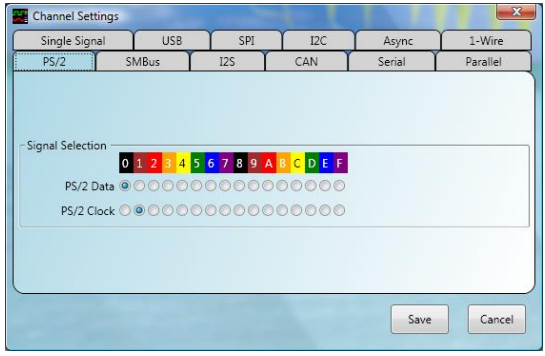
Hardware Setup

To use the Decoder you need to connect the USBee Test Pod to your hardware using the test leads. You can either connect the test leads directly to pin headers on your board, or use the test clips for attaching to your components.

The PS/2 Bus Decoder uses any one of the 24 digital signal lines (0 thru 21 + T and C) for the Clock and Data signals, and the GND (ground) line. Connect the Clock and Data to your PS/2 bus using the test leads and clips. Connect the GND line to the digital ground of your system.

Software Setup

Activate the below Channel Settings Dialog by clicking the grey tab on the left of the signal names on the main application screen.



On the above dialog box, select the signals you plan to use for the PS/2 Bus protocol.

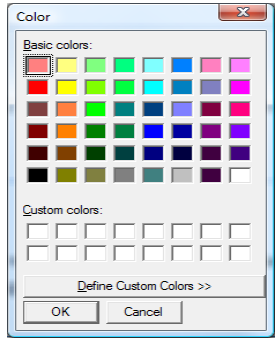
The bus traffic will be decoded as in the following screen.

SETTING VIEWING PREFERENCES

The USBee QX Suite has many ways that you can customize the display of your data, beyond the placement of the waveforms.

CURSOR COLORS

You can change the color of the Trigger, X1 and X2 cursors using the View Menu. When chosen you will see the Color Selection dialog box below. To change the colors back to their original state, use the View/Reset Colors to Default menu item.

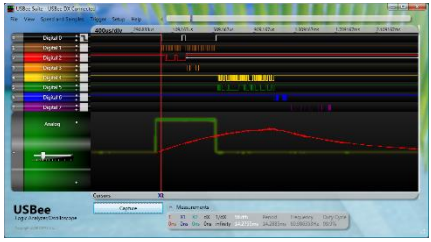


BACKGROUND COLOR

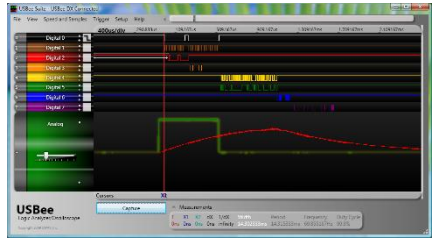
The background of the waveform screen can be set to white or black using the View | Background White or View | Background Black menu items.

GLASS APPEARANCE

Windows has added the ability to have a Glassy appearance on applications. If your system is capable of this glassy look you can use the View/Show Glass If Possible menu item to turn it on. If it is not possible, or you turn off Glass, the display shows a grey background.



With Glass On



With Glass Off

FILE OPERATIONS

Using the File menu you can start a New file, Save trace data, Open previously saved traces and Export trace data to other file formats.

CREATING A NEW FILE

To start a new file, choose File/New. This will configure the screen to the default state with all available channels enabled.

SAVING A CAPTURE FILE

After capturing a trace, you can save it to disk using the File/Save As menu item. This saves all trace data, cursor positions and screen format. The files can be saved in either Uncompressed format (.usbeesuite extension) or in Compressed format (.usbeecomp extension) to reduce drive space requirements. Saving and Opening large buffer sizes can take a while to perform the compression and saving but can greatly reduce disk space.

OPEN AND EXISTING CAPTURE FILE

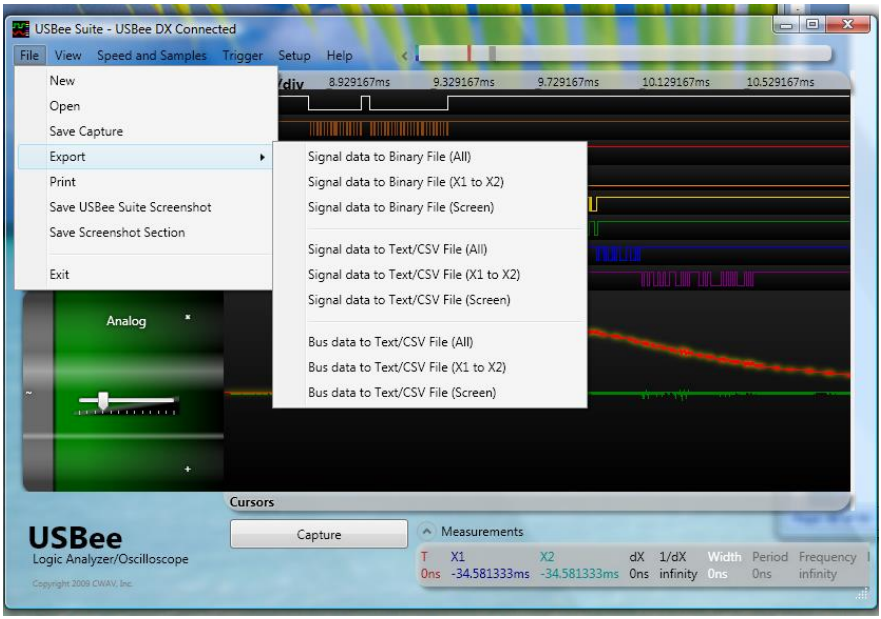
To view a previously saved capture file, us the File/Open menu item. This will load the trace data and screen format including decoder setup. Opening files with large buffer sizes can take a while to decompress and display.

RECENTLY USED FILE LIST

The USBee QX Suite maintains a recently used file list that allows you to quickly load any of the last 5 previously used files. Simply click on the file name in the File, Recently Used file list to open it.

EXPORTING CAPTURED DATA TO A FILE

Since the compressed trace files are not in easily useable format, you can use the File/Export menu items to save the trace and decoded data into formats that are easy to use.



The available options for exporting are:

- Save the Signal Data to a Binary File
- Save the Signal Data to a Text/CSV File
- Save the Bus Data to a Text/CSV file

You can specify the range of samples to export by using the All, X1 to X2, or Screen versions. Screen will output all samples viewed on the current screen, X1 to X2 will output all samples between the X1 and X2 cursor, and All will output all samples in the sample buffer. Choosing All will create VERY large files, so use with caution.

EXPORT SIGNAL DATA TO BINARY FILE

When exporting signal data to a binary file, each sample is made up of 8 bytes. Each sample was taken at the sample rate that was set at the time of capture. A single sample (8 bytes) is formatted as follows:

Byte	Description
1	Digital channels 0 to 7 (lsb= signal 0, msb = signal 7)
2	Digital channels 8 to 15 (lsb= signal 8, msb = signal 15)
3	Channel 1 Analog voltage (0=-6V, 128 = 0V, 255 = +6V)
4	Channel 2 Analog voltage (0=-6V, 128 = 0V, 255 = +6V)
5	Digital channels 16 to C (lsb= signal 16, msb = signal C)
6	Channel 3 Analog voltage (0=-6V, 128 = 0V, 255 = +6V)
7	Channel 4 Analog voltage (0=-6V, 128 = 0V, 255 = +6V)
8	Reserved

EXPORT SIGNAL DATA TO TEXT/CSV FILE

When exporting signal data to a text/csv file, each sample is output to a single line with each signal separated by a comma. Each sample was taken at the sample rate that was set at the time of capture. An example output file is formatted as follows showing a header that specifies the column labels and which signal is associated:

Time,0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,T,C,CH1,CH2,CH3,CH4
0.008739333,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,1.02,2.56,0.01,0.01
0.008739500,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,1.02,2.56,0.01,0.01
0.008739667,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,1.02,2.56,0.01,0.01
0.008739833,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,1.02,2.56,0.01,0.01
0.008740000,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,1.02,2.56,0.01,0.01
0.008740167,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,1.02,2.56,0.01,0.01
0.008740333,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,1.02,2.56,0.01,0.01
0.008740500,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,1.02,2.56,0.01,0.01
0.008740667,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,1.02,2.56,0.01,0.01
0.008740833,1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,1.02,2.56,0.01,0.01

EXPORT BUS DATA TO TEXT/CSV FILE

When exporting bus data to a text/csv file, each decoded element is output to a single line with each field separated by a comma. An example output file is formatted as follows showing a header that specifies the column labels and which signal is associated:

```
Time(seconds),Bus Name, Signal Name, Data
0.000007167,SPI 3,MOSI,FF
0.000007167,SPI 3,MISO,24
0.000106333,SPI 3,MOSI,FF
0.000106333,SPI 3,MISO,A4
0.000238667,SPI 3,MOSI,48
0.000238667,SPI 3,MISO,FF
0.000338000,SPI 3,MOSI,A8
0.000338000,SPI 3,MISO,FF
0.000437167,SPI 3,MOSI,18
0.000437167,SPI 3,MISO,FF
0.000542667,I2C 5,SDA,S - Start
0.000558500,I2C 5,SDA,A2 Write
0.000640333,I2C 5,SDA,ACK
0.000661167,I2C 5,SDA,00
0.000743000,I2C 5,SDA,ACK
0.000763667,I2C 5,SDA,0D
0.000845500,I2C 5,SDA,ACK
0.001098833,I2C 5,SDA,P - Stop
```

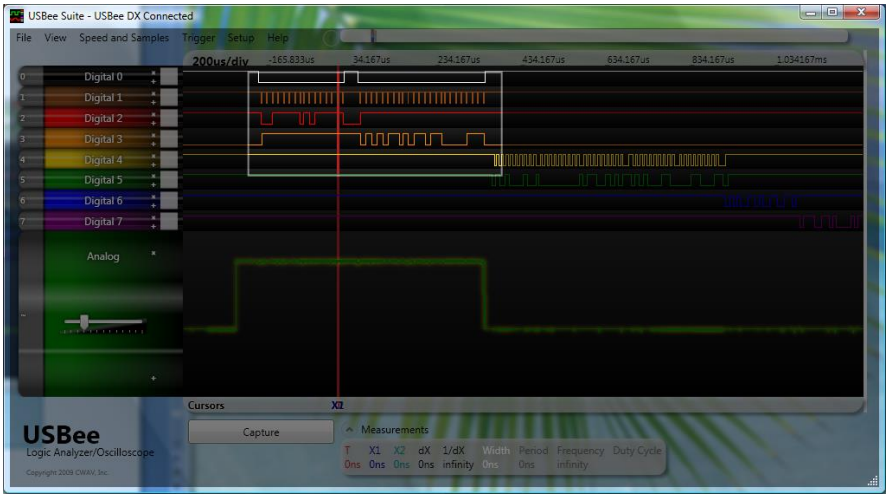
PRINTING

To print an image of the current screen, choose File/Print from the menu.

CREATING SCREEN SHOTS

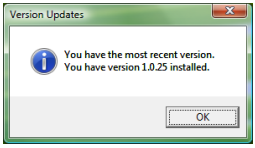
An easy way to create documentation is to take screen shots, or portions of the screen image, and save them to graphics files. You can save the entire USBee QX Suite application window to a file using the File/Save USBee QX Suite Screenshot menu item. This lets you save the image as a BMP, JPG, PNG, GIF, TIF, or WMF file to be used by your favorite graphics program.

You can use the File/Save Screenshot Section menu item to select just a portion of the screen to save. Use the left mouse button to start a rectangle that selects the region to save. When you let up on the button it will prompt you for the filename to save the image as.



SOFTWARE UPDATES

New versions of the USBee QX Suite software are posted on the USBee.com web site. To have the USBee QX Suite software check if a new version exists, use the Help/Check for Updates menu item. It will connect to the USBee.com server and determine if there is a newer version available for download. If you are up to date, the following screen will appear.



DEVELOPING YOUR OWN CUSTOM DECODERS

The USBee QX Suite allows you to create your own custom protocol decoders. Your custom decoder can process the raw signals (both analog and/or digital) and output waveline bubbles with text as seen below and even route the data or events through the PacketPresenter for further processing. See the chapter on the PacketPresenter on how to utilize this powerful feature.

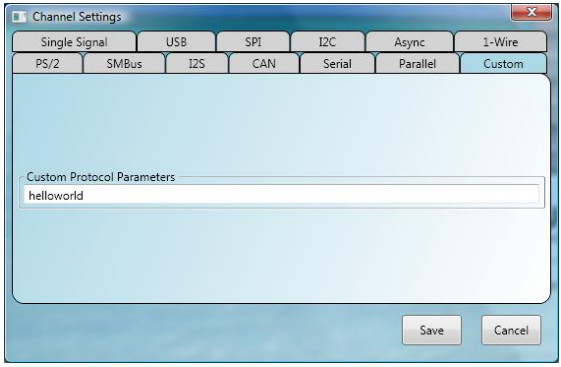
To implement a custom decoder you must create a Class Library (DLL) using the code below as an example. You can build this Class Library using the free Microsoft Visual Studio 2008 Express or newer. Our example is in Visual Basic, but can easily be ported to C or other language supported in Visual Studio.

We will first show how to use a Custom Decoder and then show how to design one.

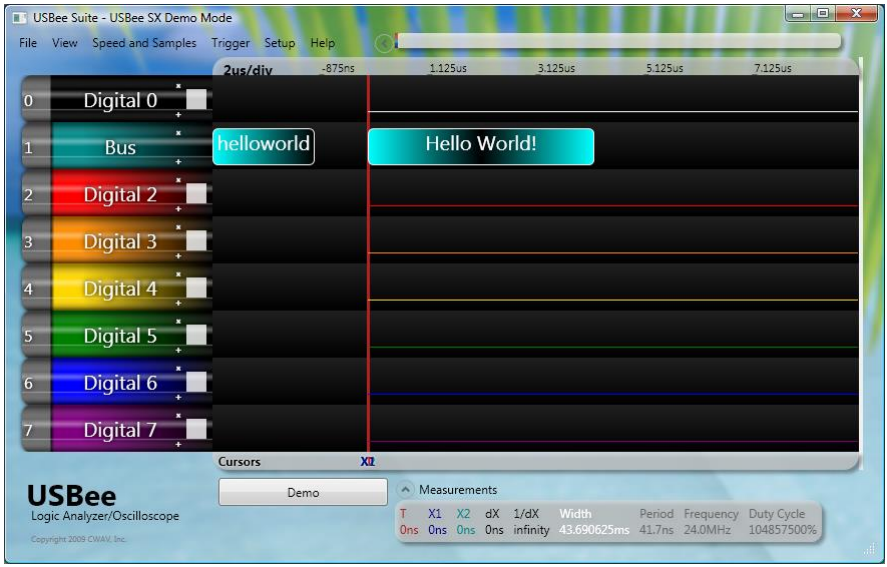
USING THE CUSTOM DECODER

Using the Custom Decoder that you build is simple. To select to use your Custom Decoder you select the Custom tab in the Channel Settings dialog box. You can then enter a set of parameters that are sent to your decoder. These parameters can specify anything you may need to determine how to decode your protocol, including which protocol, which signals to use, baud rates, inversions, etc. and is purely defined by you.

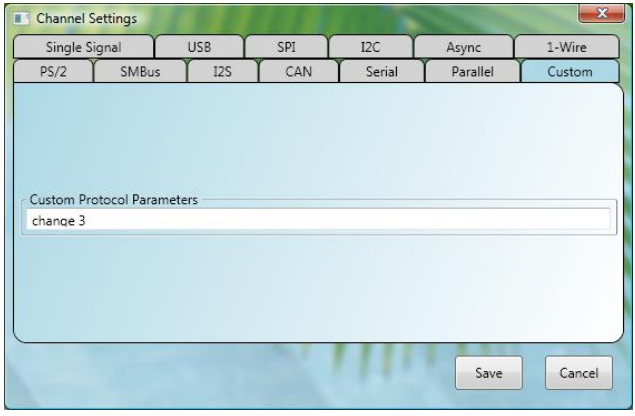
Below is the Channel Setting screen showing that we want to use our Custom Decoder on this waveline. We are also passing the text string “helloworld” to the decoder when it runs.



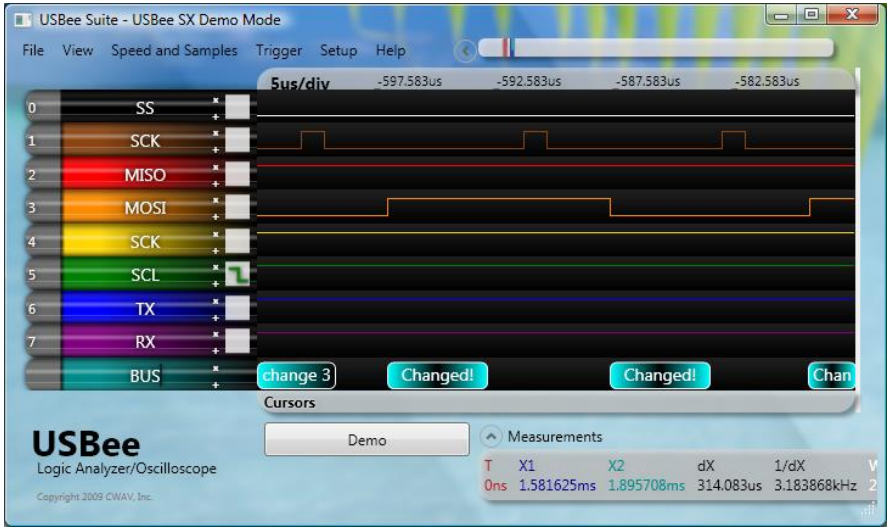
When we press Save our Decoder is run, passing the parameters to it and the resulting waveline bubbles, or Entries, are displayed. Below is the output from our VERY simple Hello World decoder which puts a “Hello World!” at the first sample.



On a different Waveline you can specify a different set of Parameters (in this case “change 3”) that indicate to the Custom Decoder to perform an entirely different decode.



As in our example decoder, this “Change” indicates to place an Entry at each change of state of the specified signal (in this case 3). The resulting display is as follows.



Obviously much more complicated protocols can be decoded using these simple methods of parameter passing and Entry displaying.

BUILDING THE CUSTOM DECODER

To implement a custom decoder you must create a Class Library (CustomUSBeeSuiteDecoderQX.DLL) using the code below as an example. This example code is also included when you install the USBee QX Suite software in the \Program Files\CWAV Inc\USBee QX Suite\CustomUSBeeSuiteDecoderQX\ directory. You can build this Class Library using the free Microsoft Visual Studio 2010 Express or newer. Our example is in Visual Basic, but can easily be ported to C or other language supported in VS2010.

The main function of a Custom Decoder code is below.

1. Receive parameters for the protocol from the User Interface
2. Access the sample data and decode the protocol based on the parameters
3. Output “Entries” that consist of a Start Sample, End Sample and a Text String
4. Optionally Output data and events to the PacketPresenter for further protocol processing

Once you create your own CustomUSBeeSuiteDecoderQX.DLL file, you simply copy your new file over the one that was provided with the original install in the \Program Files\CWAV Inc\USBee QX Suite directory. You may need to locate this file on your system and have administrator rights in order to replace it.

EXAMPLE CLASS LIBRARY CODE

Below is our example Class Library source code that performs a few different protocol decodes and displays the results on the waveline. A version that includes an actual NEC IR decoder is installed with the USBee QX Suite. Use this example to start your own.

```
Imports System.IO


Public Class CustomUSBeeSuiteDecoderQX

    Declare Function SampleData Lib "usbeeadvste.dll" Alias "?LoggedData@@YG_J_J@Z" (ByVal Index As Int64) As Integer
    Declare Function SampleDataCH1 Lib "usbeeadvste.dll" Alias "?LoggedDataCH1@@YGJ_J@Z" (ByVal Index As Int64) As Integer
    Declare Function SampleDataCH2 Lib "usbeeadvste.dll" Alias "?LoggedDataCH2@@YGJ_J@Z" (ByVal Index As Int64) As Integer
    Declare Function FindNextEdge Lib "usbeeadvste.dll" Alias "?FindNextEdge@@YG_J_JKK@Z" (ByVal start As Int64, ByVal Mask As Integer, ByVal
direction As Integer) As Int64
    Declare Function InitializePacketPresenter Lib "usbeeadvste.dll" Alias "?InitializePacketPresenter@@YGHPAD00@Z" (ByVal PPInFilename As String,
ByVal PPOutFilename As String, ByVal PPError As Byte()) As Integer
    Declare Function SendEventToPacketPresenter Lib "usbeeadvste.dll" Alias "?SendEventToPacketPresenter@@YGHPAD_JJJJ@Z" (ByVal Filename As String,
ByVal Sample As Int64, ByVal Data As Integer, ByVal Channel As Integer, ByVal Index As Integer) As Integer
    Declare Function SendDataToPacketPresenter Lib "usbeeadvste.dll" Alias "?SendDataToPacketPresenter@@YGHPAD_JJJJJ@Z" (ByVal Filename As String,
ByVal Sample As Int64, ByVal Data As Integer, ByVal Bits As Integer, ByVal Channel As Integer, ByVal Index As Integer) As Integer
    Declare Function ClosePacketPresenter Lib "usbeeadvste.dll" Alias "?ClosePacketPresenter@@YGHXZ" () As Integer

    ' The SampleData routine returns a 8 byte value that contains a single sample of all the signals
    ' The format of the 64 bits returned is as follows:
    '
    ' MSB                                                     LSB
    '                         22221111                 111111
    ' 00000000wwwwwwwwzzzzzzzz32109876  XXXXXXXXYYYYYYYY5432109876543210
    '
    ' where
    '       wwwwwwww is Channel 4 Analog value (0=-6V, 255 = +6V)
    '       zzzzzzzz is Channel 3 Analog value (0=-6V, 255 = +6V)
    '       XXXXXXXX is Channel 2 Analog value (0=-6V, 255 = +6V)
    '       YYYYYYYY is Channel 1 Analog value (0=-6V, 255 = +6V)
    '       23 is logic level (0 or 1) for channel C
    '       22 is logic level (0 or 1) for channel T
    '       21 is logic level (0 or 1) for channel 21
    '       20 is logic level (0 or 1) for channel 20

    '       ...
    '       0 is logic level (0 or 1) for channel 0
    '
    ' FindNextEdge routine scans quickly through the sample buffer starting at the start sample number to find the next sample
    ' that sees an edge on any of the masked channels.  Mask bits are aligned as above with a 1 being considered, 0 being ignored.
    ' direction 1 = forward, 0 = backward.  FindNextEdge should be used instead of SampleData whenever possible since it is much faster.
    ' Return value is the sample number at the next edge or -1 if there is no more edges in that direction.

    Dim GTriggerSample As Int64
    Dim GX1Sample As Int64
    Dim GX2Sample As Int64

    Public Sub SetCaptureParameters(ByVal TriggerSample As Int64, ByVal X1Sample As Int64, ByVal X2Sample As Int64)
        ' This routine is called right at the end of a capture to pass the positions of the Trigger and X1 and X2 Cursors to the
        ' custom decoding process.
        GTriggerSample = TriggerSample
        GX1Sample = X1Sample
        GX2Sample = X2Sample

    End Sub


    Public Sub DecodeCustom(ByVal OutFilename As String, ByVal NumberOfSamples As Int64, ByVal SamplingRate As Integer, ByVal Parameters As String,
ByVal PPInFilename As String, ByVal PPOutFilename As String, ByRef PPError() As Byte)
        Dim OldSample As UInteger

        Dim PPOn As Boolean = False

        ' Determine if there is a PacketPresenter definition file associated with this waveline.  If so, initialize the PacketPresenter system to
output the packet
        ' information to the output file.

        If PPInFilename <> "" Then
            Dim retval = InitializePacketPresenter(PPInFilename, PPOutFilename, PPError)
            If (PPError(0) <> 0) Then
                Exit Sub
            End If
            PPOn = True
        Else
            PPOn = False
        End If

        Try

            ' This is a custom bus decoder Processing Routine
            '
            ' The passed in variables are as follows:
            ' OutFilename     - the file that all of the decoded Entries get written to.  This is the file that the USBee Suite
            '                   will read to display the data on the waveline.
            ' ActualNumberOfSamples - How many samples are in the sample buffer
            ' SamplingRate    - The rate that the samples were taken in sps.  24000000 = 24Msps...
            ' Parameters      - User defined string passed from the USBee Suite user interface Channel Setting for the custom decoder.
            '                   Use this string to pass in any parameters that your decoder needs to know, such as what channels to use
            '                   in decoding, which protocol if you have multiple protocols supported here, and how you want the data formatted.

            ' Below is an example set of a few Custom Protocol decoders that show how to access the sample buffer and how to generate output that get
sent to the
            ' screen (through WriteEntry) and through the PacketPresenter (through SendDataToPacketPresenter and SendEventToPacketPresenter)

            ' Setup the File Stream that stores the Output Entry Information
            Dim FS As New FileStream(OutFilename, FileMode.Append, FileAccess.Write)
            Dim BW As New BinaryWriter(FS)
            Dim Sample As Int64

            SampleData(0)   ' Initializes the sample retrieval
```

```
            ' Since this file supports many different custom decoders, we need to see which one to run for this pass based on the Parameters string.
This
            ' Parameters is a string that the use enters in the Suite GUI for this Custom waveline.  The entire string contains all of the paramers
for the decode
            ' and therefore needs to be parsed to extract any parameter settings for this decode.

            If CBool(InStr(Parameters.ToUpper, "CHANGE")) Then
                ' Sample Decoder that just detects when a signal changes state
                ' The signal to use for the detection is specified in the Parameters as the second parameter

                Dim Params() = Parameters.Split(CChar(" ,-"))
                Dim SignalToUse As Double = Val(Params(1))
                Dim SignalMask As Integer = 1 << CInt(SignalToUse)       ' Make the mask that will mask off the channel we want in the sample

                ' Now go from the start of the samples to the end and process the decoder
                For Sample = 0 To NumberOfSamples - 1
                    ' This example decoder places a label at every transition of a digital signal
                    Dim NextEdge = FindNextEdge(Sample, SignalMask, 1)
                    If NextEdge >= 0 Then       ' Edge was found

                        ' Write out a waveline bubble with text.  This text will be displayed inline with all of the waveforms as the user scrolls and
zooms
                        WriteEntry(BW, NextEdge, NextEdge + 100, "Changed! S:" & Sample & "N:" & NextEdge)

                        ' Send this data to the PacketPresenter to further process this protocol.  In this case we just send a 1 or 0 based on rising
or falling edge.
                        ' Not terribly useful by itself, but shows how you can send a bit/byte strem through the PacketPresenter from this custom
decoder.

                        Dim DataToSend As Integer
                        If (SampleData(NextEdge) And SignalMask) Then
                            DataToSend = 1
                        Else
                            DataToSend = 0
                        End If

                        If PPOn Then SendDataToPacketPresenter(PPInFilename, NextEdge, DataToSend, 8, 1, 0) ' Send the data to the Packet Presenter

                    Else
                        ' There are no more edges so end
                        Exit For
                    End If
                    Sample = NextEdge - 1

                Next

            ElseIf CBool(InStr(Parameters.ToUpper, "RISE")) Then
                ' Sample Decoder that just detects when a signal changes state
                ' The signal to use for the detection is specified in the Parameters as the second parameter

                Dim Params() = Parameters.Split(CChar(" ,-"))
                Dim SignalToUse As Double = Val(Params(1))
                Dim SignalMask As Integer = 1 << CInt(SignalToUse)       ' Make the mask that will mask off the channel we want in the sample

                ' Now go from the start of the samples to the end and process the decoder
                For Sample = 0 To NumberOfSamples - 1
                    ' This example decoder places a label at every transition of digital signal 0
                    Dim DigitalChannel As UInteger = CUInt(SampleData(Sample) And SignalMask)
                    If (DigitalChannel <> OldSample) And (OldSample = 0) Then
                        WriteEntry(BW, Sample, Sample + 100, "Rise!")
                    End If
                    OldSample = DigitalChannel
                Next

            ElseIf CBool(InStr(Parameters.ToUpper, "HELLOWORLD")) Then

                ' Simplest Decoder Possible
                ' Print Hello World at the start of the buffer

                WriteEntry(BW, 0, 100, "Hello World!")
                WriteEntry(BW, GTriggerSample, GTriggerSample + 100, "Trigger Is Here!")
                WriteEntry(BW, GX1Sample, GX1Sample + 100, "X1 Is Here!")
                WriteEntry(BW, GX2Sample, GX2Sample + 100, "X2 Is Here!")

            ElseIf CBool(InStr(Parameters.ToUpper, "NECIR")) Then
                ' NEC IR Decoder 3.0

                WriteEntry(BW, 0, 100, "NEC IR Decoder 3.0")


                Dim Params() = Parameters.Split(CChar(" ,-"))
                Dim SignalToUse As Double = Val(Params(1))
                Dim SignalMask As Integer = 1 << CInt(SignalToUse)      'Make the mask that will mask off the channel we want in the sample

                Const LOOKING_FOR_HEADER As Integer = 1
                Const LOOKING_FOR_BITS As Integer = 2
                Dim DecodeState As Integer = LOOKING_FOR_HEADER     ' Holds what state of the decoder we are in

                Dim ByteAccumulator As Integer = 0                  ' Holds the accumulated bits for each byte
                Dim BitCounter As Integer = 0                       ' Holds how many bits we have accumulated in this byte so far
                Dim ByteStartSample As Int64                      ' Holds the sample at the start of the byte

                Dim Data As UInteger                                ' Holds the state of the signal at the current sample
                Dim tEdge1 As Int64                               ' Where the first edge is
                Dim tEdge2 As Int64                               ' Where the second edge is
                Dim tPulseWidth As Double                           ' The pulsewidth in seconds

                ' Now go from the start of the samples to the end and process the signal
                For Sample = 0 To NumberOfSamples - 1

                    Data = CUInt(SampleData(Sample) And SignalMask)

                    If DecodeState = LOOKING_FOR_HEADER Then

                        If Data <> 0 Then
                            ' We found a High which starts the Header
                            ' Now look for the next edge

                            tEdge1 = FindNextEdge(Sample, SignalMask, 1)

                            If tEdge1 >= 0 Then

                                ' Check to see if this falling edge is in the right timeframe
                                tPulseWidth = (tEdge1 - Sample) / SamplingRate

                                If (tPulseWidth >= 0.008) And (tPulseWidth <= 0.01) Then
```

```
                ' Now look for the rising edge

                tEdge2 = FindNextEdge(tEdge1, SignalMask, 1)

                If tEdge2 >= 0 Then
                    ' Check to see if this rising edge is in the right timeframe
                    tPulseWidth = (tEdge2 - tEdge1) / SamplingRate
                    If (tPulseWidth >= 0.004) And (tPulseWidth <= 0.005) Then
                        ' Great!  Valid Header Format!  Look for bits from this point on

                        ' Write out a Header Marker (remove this if you don't need the header)
                        WriteEntry(BW, Sample, tEdge2, "Lead Code")

                        DecodeState = LOOKING_FOR_BITS
                        Sample = tEdge2

                        ' Initialize the Byte Accumulation variables
                        ByteStartSample = Sample
                        ByteAccumulator = 0
                        BitCounter = 0

                        Continue For
                    ElseIf (tPulseWidth >= 0.002) And (tPulseWidth <= 0.003) Then
                        ' Great!  Valid Repeat Format!

                        ' Find the next falling edge to complete the Repeat
                        tEdge2 = FindNextEdge(tEdge2, SignalMask, 1)

                        ' Write out a Repeat Marker (remove this if you don't need the Repeat)
                        WriteEntry(BW, Sample, tEdge2, "Repeat")

                        Sample = tEdge2
                        Continue For

                    Else
                        ' Pulse is not the right size so bail and keep looking
                        Sample = tEdge2
                        Continue For
                    End If
                Else
                    ' No edges at all!  So we are done
                    Exit For
                End If

            Else
                ' Pulse is not the right size so bail and keep looking
                Sample = tEdge1
                Continue For
            End If
        Else
            ' No edges at all!  So we are done
            Exit For
        End If

    End If

ElseIf DecodeState = LOOKING_FOR_BITS Then

    If BitCounter = 8 Then
        ' We have an entire byte worth of data so output the information
        WriteEntry(BW, ByteStartSample, tEdge2, Hex(ByteAccumulator))
        BitCounter = 0
        ByteAccumulator = 0
    End If

    If Data <> 0 Then
        ' We found a High which starts the bit
        ' Now look for the next edge

        tEdge1 = FindNextEdge(Sample, SignalMask, 1)

        If tEdge1 >= 0 Then

            ' Check to see if this falling edge is in the right timeframe
            tPulseWidth = (tEdge1 - Sample) / SamplingRate

            If (tPulseWidth >= 0.0005) And (tPulseWidth <= 0.0007) Then
                ' Good start of a bit
                ' Now look for the rising edge

                tEdge2 = FindNextEdge(tEdge1, SignalMask, 1)

                If tEdge2 >= 0 Then
                    ' Check to see if this rising edge is in the right timeframe for a logic "0"
                    tPulseWidth = (tEdge2 - tEdge1) / SamplingRate
                    If (tPulseWidth >= 0.0004) And (tPulseWidth <= 0.0006) Then
                        ' Great!  Valid 0 Bit Format!

                        ' Write out a Bit Marker (remove this if you don't need the bit)
                        'WriteEntry(BW, CUInt(Sample), CUInt(tEdge2), "0")

                        ' Add this bit to the accumulators (LSB first)
                        ByteAccumulator = ByteAccumulator >> 1    ' Shift the Accumulator
                        ByteAccumulator = ByteAccumulator And &H7F ' Clear out the MSBit

                        ' Mark the start of the byte if so
                        If BitCounter = 0 Then ByteStartSample = Sample

                        ' Next Bit next time
                        BitCounter = BitCounter + 1

                        Sample = tEdge2
                        Continue For
                    ElseIf (tPulseWidth >= 0.001) And (tPulseWidth <= 0.002) Then
                        ' Great!  Valid 1 Bit Format!

                        ' Write out a Bit Marker (remove this if you don't need the bit)
                        'WriteEntry(BW, CUInt(Sample), CUInt(tEdge2), "1")

                        ' Add this bit to the accumulators (LSB first)
                        ByteAccumulator = ByteAccumulator >> 1    ' Shift the Accumulator
                        ByteAccumulator = ByteAccumulator Or &H80 ' Set the MSBit

                        ' Mark the start of the byte if so
                        If BitCounter = 0 Then ByteStartSample = Sample
```

```
                                ' Next Bit next time
                                BitCounter = BitCounter + 1

                                Sample = tEdge2
                                Continue For

                            Else
                                ' Pulse is not the right size so bail and keep looking
                                DecodeState = LOOKING_FOR_HEADER
                                Sample = tEdge2
                                Continue For
                            End If
                        Else
                            ' No edges at all!  So we are done
                            Exit For
                        End If

                    Else
                        ' Pulse is not the right size so bail and keep looking
                        Sample = tEdge1
                        DecodeState = LOOKING_FOR_HEADER
                        Continue For
                    End If
                Else
                    ' No edges at all!  So we are done
                    Exit For
                End If

            End If

        End If
    Next


ElseIf CBool(InStr(Parameters.ToUpper, "BIPHASE")) Then
    ' BiPhase Decoder

    'WriteEntry(BW, 0, 100, "BiPhase Decoder")

    Dim Params() = Parameters.Split(CChar(" ,-"))
    Dim SignalToUse As Double = Val(Params(1))
    Dim SignalMask As Integer = 1 << CInt(SignalToUse)      'Make the mask that will mask off the channel we want in the sample

    Const LOOKING_FOR_START As Integer = 1      ' Look for a 0
    Const LOOKING_FOR_BITS As Integer = 2       ' Then look for a 1 (starts the 7E)
    Const LOOKING_FOR_START_BIT_2 As Integer = 3
    Dim DecodeState As Integer = LOOKING_FOR_START     ' Holds what state of the decoder we are in

    Dim ByteAccumulator As Integer = 0                  ' Holds the accumulated bits for each byte
    Dim BitCounter As Integer = 0                       ' Holds how many bits we have accumulated in this byte so far
    Dim ByteStartSample As Int64                       ' Holds the sample at the start of the byte

    Dim Data As UInteger                                ' Holds the state of the signal at the current sample
    Dim tEdge1 As Int64                                ' Where the first edge is
    Dim tEdge2 As Int64                                ' Where the second edge is
    Dim tPulseWidth As Double                           ' The pulsewidth in seconds
    Dim tBits As Integer
    Dim tNumberOfOnes As Integer                        ' Used to remove Bit stuffing

    ' Now go from the start of the samples to the end and process the signal

    ' Find the first edge of the data signal (assumes that it is the start edge of a bit)
    Sample = 0
    Data = CUInt(FindNextEdge(Sample, SignalMask, 1) And SignalMask)
    tBits = 0

    For Sample = Sample To NumberOfSamples - 1


        If DecodeState = LOOKING_FOR_START Then

            ' Now look for the next edge

            tEdge1 = FindNextEdge(Sample, SignalMask, 1)

            If tEdge1 >= 0 Then     ' We found the next edge

                ' Check to see if this falling edge is in the right timeframe
                tPulseWidth = (tEdge1 - Sample) / SamplingRate

                If (tPulseWidth >= 0.000004) And (tPulseWidth <= 0.000011) Then

                    tBits = tBits + 1

                    ' The bit is a 0, which starts the byte stream

                    ' Now get us to the start of the next bit
                    tEdge2 = FindNextEdge(tEdge1, SignalMask, 1)

                    ' Write out a bit data marker
                    'WriteEntry(BW, Sample, tEdge2, "0[090]")

                    If (tBits > 12) Then     ' Only start looking for a 0 after a few bit times to remove junk at front of packets
                        DecodeState = LOOKING_FOR_START_BIT_2
                    End If

                    ' Initialize the Byte Accumulation variables
                    ByteStartSample = Sample
                    ByteAccumulator = 0
                    BitCounter = 1

                    tNumberOfOnes = 0       ' Reset the bit stuffing removal

                    Sample = tEdge2

                ElseIf (tPulseWidth >= 0.000012) And (tPulseWidth <= 0.000019) Then

                    ' The bit is a 1

                    ' We are already at the start of the next bit
                    ' Write out a bit data marker
                    'WriteEntry(BW, Sample, tEdge1, "1")
                    Sample = tEdge1

                    tBits = tBits + 1

                Else
```

```
                            ' Pulse is not the right size so bail and keep looking
                            'WriteEntry(BW, Sample, tEdge1, "x[900]")
                            Sample = tEdge1
                            tBits = 0
                            Continue For
                        End If
                    Else
                        ' No edges at all!  So we are done
                        Exit For
                    End If

                ElseIf DecodeState = LOOKING_FOR_START_BIT_2 Then

                    ' Now look for the next edge

                    tEdge1 = FindNextEdge(Sample, SignalMask, 1)

                    If tEdge1 >= 0 Then     ' We found the next edge

                        ' Check to see if this falling edge is in the right timeframe
                        tPulseWidth = (tEdge1 - Sample) / SamplingRate

                        If (tPulseWidth >= 0.000004) And (tPulseWidth <= 0.000011) Then

                            ' The bit is a 0, which means we are not aligned.  But this may be the 0 that starts the 7E, so stay in this level to
see if next bit is a 1

                            ' Now get us to the start of the next bit
                            tEdge2 = FindNextEdge(tEdge1, SignalMask, 1)
                            ByteStartSample = Sample

                            Sample = tEdge2

                        ElseIf (tPulseWidth >= 0.000012) And (tPulseWidth <= 0.000019) Then

                            ' The bit is a 1

                            DecodeState = LOOKING_FOR_BITS
                            ByteAccumulator = 128    ' Bits are shifted in from the MSBit
                            BitCounter = 2
                            tNumberOfOnes = 1       ' Reset the bit stuffing removal

                            ' We are already at the start of the next bit
                            ' Write out a bit data marker
                            'WriteEntry(BW, Sample, tEdge1, "1")
                            Sample = tEdge1

                            tBits = tBits + 1

                        Else
                            ' Pulse is not the right size so bail and keep looking
                            'WriteEntry(BW, Sample, tEdge1, "x[900]")
                            Sample = tEdge1
                            tBits = 0
                            Continue For
                        End If
                    Else
                        ' No edges at all!  So we are done
                        Exit For
                    End If


                ElseIf DecodeState = LOOKING_FOR_BITS Then
                    ' Now look for the next edge

                    If BitCounter = 8 Then
                        ' We have an entire byte worth of data so output the information
                        WriteEntry(BW, ByteStartSample, Sample, Hex(ByteAccumulator))

                        If PPOn Then SendDataToPacketPresenter(PPInFilename, ByteStartSample, ByteAccumulator, 8, 1, 0)

                        BitCounter = 0
                        ByteAccumulator = 0
                    End If

                    tEdge1 = FindNextEdge(Sample, SignalMask, 1)


                    If tEdge1 >= 0 Then     ' We found the next edge

                        ' Check to see if this falling edge is in the right timeframe
                        tPulseWidth = (tEdge1 - Sample) / SamplingRate

                        If (tPulseWidth >= 0.000004) And (tPulseWidth <= 0.000011) Then

                            ' The bit is a 0, which starts the byte stream

                            ' Now get us to the start of the next bit
                            tEdge2 = FindNextEdge(tEdge1, SignalMask, 1)

                            ' Validate that the duration from the previous edge to this edge is within limits.
                            tPulseWidth = (tEdge2 - tEdge1) / SamplingRate

                            If (tPulseWidth > 0.000011) Or (tPulseWidth < 0.000004) Then
                                'WriteEntry(BW, Sample, Sample + 10, "Bogus 2!")
                                Sample = tEdge2
                                DecodeState = LOOKING_FOR_START
                                tBits = 0
                                Continue For
                            End If

                            ' Write out a bit data marker
                            'WriteEntry(BW, Sample, tEdge2, "0[009]")

                            ' Now check to see if we need to ignore this bit due to bit stuffing
                            If (tNumberOfOnes <> 5) Then
                                ' Add this bit to the accumulators (LSB first)
                                ByteAccumulator = ByteAccumulator >> 1    ' Shift the Accumulator
                                ByteAccumulator = ByteAccumulator And &H7F ' Clear out the MSBit

                                ' Mark the start of the byte if so
                                If BitCounter = 0 Then ByteStartSample = Sample

                                ' Next Bit next time
                                BitCounter = BitCounter + 1
```

```
                    End If

                    tNumberOfOnes = 0

                    Sample = tEdge2

                ElseIf (tPulseWidth >= 0.000012) And (tPulseWidth <= 0.000019) Then

                    ' The bit is a 1

                    tNumberOfOnes = tNumberOfOnes + 1

                    ' We are already at the start of the next bit
                    ' Write out a bit data marker
                    'WriteEntry(BW, Sample, tEdge1, "1[009]")

                    ' Add this bit to the accumulators (LSB first)
                    ByteAccumulator = ByteAccumulator >> 1     ' Shift the Accumulator
                    ByteAccumulator = ByteAccumulator Or &H80 ' Set the MSBit

                    ' Mark the start of the byte if so
                    If BitCounter = 0 Then ByteStartSample = Sample

                    ' Next Bit next time
                    BitCounter = BitCounter + 1

                    Sample = tEdge1

                Else
                    ' Pulse is not the right size so bail and keep looking
                    'WriteEntry(BW, Sample, tEdge1, "x[900]")
                    'WriteEntry(BW, Sample, Sample + 10, "Bogus!")
                    Sample = tEdge1
                    DecodeState = LOOKING_FOR_START
                    tBits = 0


                    Continue For
                End If
            Else
                ' No edges at all!  So we are done
                Exit For
            End If

        End If
    Next

ElseIf CBool(InStr(Parameters.ToUpper, "ARINC429")) Then
    ' NEC IR Decoder 3.0

    WriteEntry(BW, 0, 100, "ARINC 429 Decoder")


    Dim Params() = Parameters.Split(CChar(" ,-"))
    Dim SignalToUse As Double = Val(Params(1))
    Dim Data As Integer

    Dim LevelHigh1 As Integer
    Dim LevelLow1 As Integer
    Dim LevelHigh2 As Integer
    Dim LevelLow2 As Integer

    LevelLow1 = &H200 - 128
    LevelLow2 = &H200 - 256
    LevelHigh1 = &H200 + 128
    LevelHigh2 = &H200 + 256

    Const LOOKING_FOR_START As Integer = 1
    Const LOOKING_FOR_HIGH_END As Integer = 2
    Const LOOKING_FOR_LOW_END As Integer = 3

    Dim DecodeState As Integer = LOOKING_FOR_START     ' Holds what state of the decoder we are in

    Dim ByteAccumulator As Integer = 0                  ' Holds the accumulated bits for each byte
    Dim BitCounter As Integer = 0                       ' Holds how many bits we have accumulated in this byte so far
    Dim ByteStartSample As Int64                       ' Holds the sample at the start of the byte


    For Sample = 0 To NumberOfSamples - 1

        Data = SampleDataCH1(Sample)

        If DecodeState = LOOKING_FOR_START Then


            If Data > LevelHigh2 Then
                DecodeState = LOOKING_FOR_HIGH_END
                ByteStartSample = Sample
            End If

            If Data < LevelLow2 Then
                DecodeState = LOOKING_FOR_LOW_END
                ByteStartSample = Sample
            End If

        ElseIf DecodeState = LOOKING_FOR_HIGH_END Then
            If Data < LevelHigh1 Then
                DecodeState = LOOKING_FOR_START
                WriteEntry(BW, ByteStartSample, Sample, "0")

                If PPOn Then SendDataToPacketPresenter(0, ByteStartSample, 0, 1, 1, 0)

            End If

        ElseIf DecodeState = LOOKING_FOR_LOW_END Then
            If Data > LevelLow1 Then
                DecodeState = LOOKING_FOR_START
                WriteEntry(BW, ByteStartSample, Sample, "1")

                If PPOn Then SendDataToPacketPresenter(0, ByteStartSample, 1, 1, 1, 0)

            End If

        End If

    Next
```

```
            End If
            ' Close the Output File
            FS.Close()

        Catch ex As Exception

        End Try

        ' Close the PacketPresenter output file
        If PPOn Then ClosePacketPresenter()

    End Sub


    Public Sub WriteEntry(ByRef BW As BinaryWriter, ByVal StartSample As Int64, ByVal EndSample As Int64, ByRef TextString As String)

        ' DO NOT CHANGE THIS ROUTINE!!!
        ' This routine writes the Entry in the file format that is used by the Custom Decoder
        ' This entry specifies the Start Sample, End Sample and the text string to display
        Try

            BW.Write(StartSample)
            BW.Write(EndSample)

            ' Write the length of the string in bytes (include the 0 at the end in the count)
            Dim tStrLen As UInt32
            tStrLen = CUInt(TextString.Length + 1)
            BW.Write(tStrLen)

            ' Now write out the characters one byte at a time and put a 0 at the end
            For x As Integer = 0 To CInt(tStrLen - 2)
                BW.Write(CByte(Asc(TextString.Chars(x))))
            Next
            BW.Write(CByte(0))

        Catch ex As Exception

        End Try


    End Sub

End Class
```

CUSTOM DECODER PARAMETERS

As you can see in the above code, the Parameter string that is passed from the User Interface to your decoder can be used for a number of purposes. First, it can specify which decoder to run. If you have more than one protocol that you want your decoder to handle, you can select which decoder runs using this text string. For example, in our example Custom Decoder we have a few decoders possible, “CHANGE”, RISE”, “HELLOWORLD” and “NECIR”. Each decoder processes the data differently and outputs different results based on the algorithms.

You can also supply additional parameters in the text string as well as we do in the CHANGE and RISE decoders. The additional parameter in these examples indicates which signal to use to decode.

Again, the definition and use of the Parameter string is entirely up to you but provides an easy to use and simple to implement way to control the behavior of your decoder.

ACCESSING SAMPLE DATA TO PERFORM DECODE

To access each individual sample stored in the sample buffer you use the SampleData or FindNextEdge calls as shown above. This returns a 64-bit value that includes all of the channels levels at that sample time. The format of the 64 bits is as follows:

```
MSB                                                                   LSB
                         22221111                    111111
00000000wwwwwwwwzzzzzzzz32109876  XXXXXXXXYYYYYYYY5432109876543210

where
      wwwwwwww is Channel 4 Analog value (0=-6V, 255 = +6V)
      zzzzzzzz is Channel 3 Analog value (0=-6V, 255 = +6V)
      XXXXXXXX is Channel 2 Analog value (0=-6V, 255 = +6V)
      YYYYYYYY is Channel 1 Analog value (0=-6V, 255 = +6V)
      23 is logic level (0 or 1) for channel C
      22 is logic level (0 or 1) for channel T
      21 is logic level (0 or 1) for channel 21
      20 is logic level (0 or 1) for channel 20

      ...
      0 is logic level (0 or 1) for channel 0
```

Decoding any given protocol then entails going through the samples from beginning to end and masking off the channels you need to decode, accumulating decoded bits/bytes along the way and determining what the result is that you want to display.

Since the USBee QX uses sample compression, there may be trillions of actual samples. Therefore, it is best, and will result in faster decoder times, to use the FindNextEdge routine instead of individual SampleData calls when processing a protocol. This routine understands the compression algorithm and does not waste time processing compressed samples.

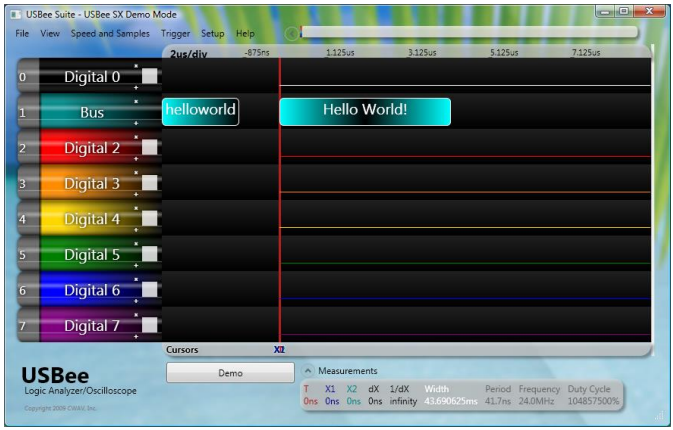
OUTPUTTING ENTRIES THAT WILL GET DISPLAYED ON THE SCREEN

Once your decoder has determined the result of the decoded data that you want displayed on the screen, you call the WriteEntry routine above. This gets passed the Start Sample, End Sample and Text String. Entries appear as rounded rectangles on the screen on the associated wave line and are locked to the samples that you specify.

For example, the following call places the “Hello World!” string on the screen stretching from the first sample to the 100th sample.

```
WriteEntry(OutFile, 0, 100, "Hello World!")
```

The output is as follows:



SENDING DATA AND EVENTS THAT WILL GET DISPLAYED ON THE PACKETPRESENTER

Your custom decoder can also send data and events to the PacketPresenter for processing and display in the PacketPresenter system. As seen in the example code, once the system is initialized, you can call the **SendDataToPacketPresenter** and **SendEventToPacketPresenter** routines to pass the data.

SendDataToPacketPresenter sends data bits to be run through the PacketPresenter. The routine takes a filename which is passed in from the calling function, a sample number (equating to a relative timestamp of this data), the data to send, how many bits are included, which channel to data is for(X or Y) and a reserved parameter called Index (set to 0).

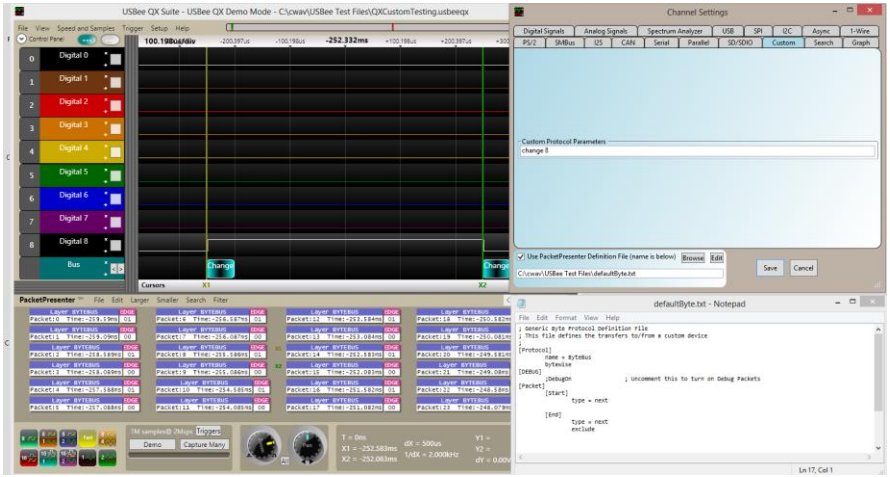
```
SendDataToPacketPresenter (ByVal Filename As String, ByVal Sample As Int64,
ByVal Data As Integer, ByVal Bits As Integer, ByVal Channel As Integer, ByVal
Index As Integer)
```

SendEventToPacketPresenter send events to be run through the PacketPresenter. The routine takes a filename which is passed in from the calling function, a sample number (equating to a relative timestamp of this data), the event to send, which channel to data is for(X or Y) and a reserved parameter called Index (set to 0).

```
SendEventToPacketPresenter (ByVal Filename As String, ByVal Sample As Int64,
ByVal Data As Integer, ByVal Channel As Integer, ByVal Index As Integer)
```

Events typically indicate bus states that are not contained in the data, for example a START bit on the I2C bus. Your custom decoder can define and use the Events any way that is required. It is up to you to define any events your protocol needs to help packetize and process your data in the PacketPresenter.

For example, the following screen shot shows the PacketPresenter definition file, Custom waveline settings and the resulting capture from running the above example code on a toggling line.



CHANGING THE BACKGROUND COLOR OF OUTPUTTED ENTRIES

You can control the background color of the entire WriteEntry item by embedding a color code anywhere into the text string. Color codes are in the following format:

[RGB]

Where:

R is the Red value and is a single digit of 0 thru 9.

G is the Green value and is a single digit of 0 thru 9.

B is the Blue value and is a single digit of 0 thru 9.

For example:

To output an Entry that has a bright green background, use the following:

```
WriteEntry(OutFile, 0, 100, "Hello World![090]")
```

To output an Entry that has a dark red background, use the following:

```
WriteEntry(OutFile, 0, 100, "Hello World![400]")
```

Some common color codes are as follows:

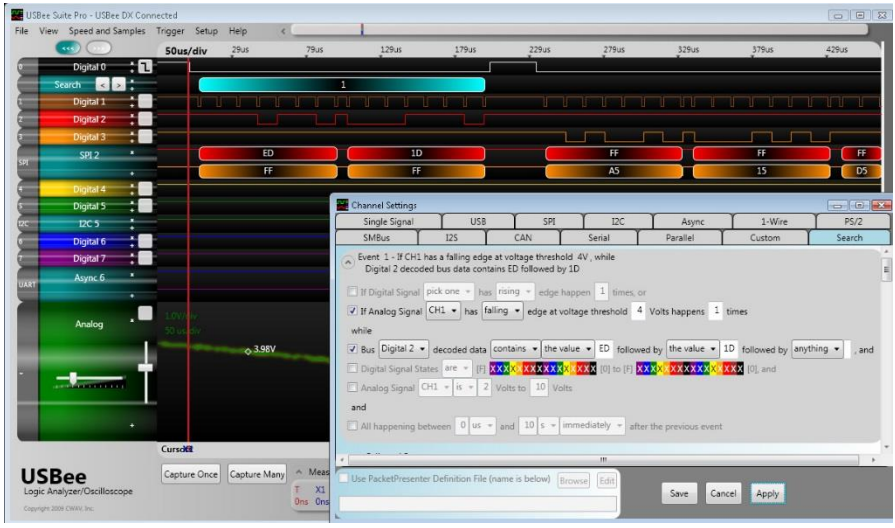
If you do not embed a color code, the background color will be a light cyan.

SMART SEARCH

The USBee QX Suite Smart Search highlights the sections of your trace matching your areas of interest so that you don't need to waste time hunting for the data you need.

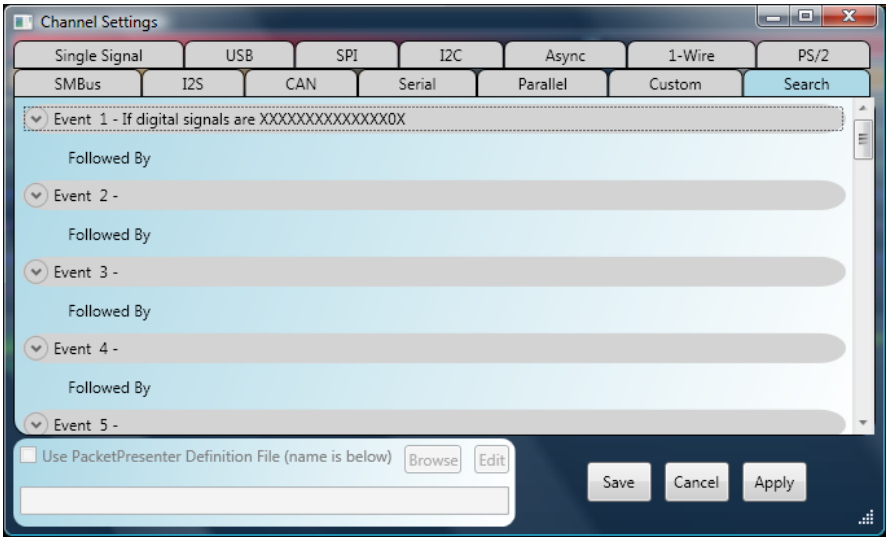
You can specify up to 32 levels of search events that are any combination of bus decoded traffic, states or edges of digital or analog signals, inside or outside of analog voltage ranges and/or digital ranges, and all validated by time specific windows.

Once specified you can pan through the occurrences of your searched items with the click of the mouse and see the total number of times the searched events occur.

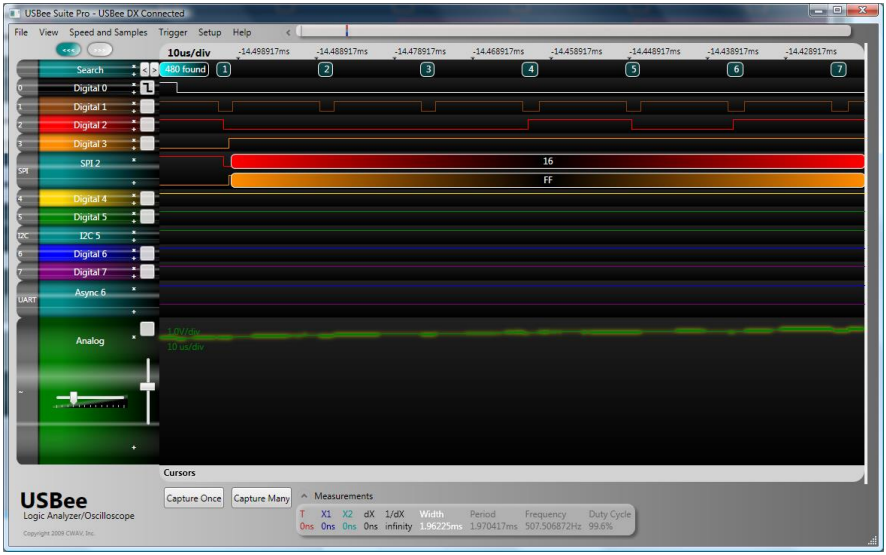

USBee Suite Pro - USBee DX Connected
File View Speed and Samples Trigger Setup Help
50us/div
Digital 0
Search
Digital 1
Digital 2
Digital 3
SPI 2
Digital 4
Digital 5
I2C 5
Digital 6
Digital 7
Async 6
Analog
ED 1D FF FF FF
FF FF A5 15 D5
Channel Settings
Single Signal USB SPI I2C Async 1-Wire PS/2
SMBus I2S CAN Serial Parallel Custom Search
Event 1 - If CH1 has a falling edge at voltage threshold 4V, while
Digital 2 decoded bus data contains ED followed by 1D
If Digital Signal pick one has rising edge happen 1 times, or
If Analog Signal CH1 has falling edge at voltage threshold 4 Volts happens 1 times
while
Bus Digital 2 decoded data contains the value ED followed by the value 1D followed by anything , and
Digital Signal States are
Analog Signal CH1 is 2 Volts to 10 Volts
and
All happening between 0 us and 10 s immediately after the previous event
Use PacketPresenter Definition File (name is below)
Browse
Edit
Save
Cancel
Apply
USBee
Logic Analyzer/Oscilloscope
Capture Once
Capture Many

ADDING A SEARCH LINE

To add a Smart Search line on the display, click on the grey tab to the left of the line you want to change (or click the "+" sign to add a new wave line). Once you click on the **Search Tab** you will see the Channel Settings dialog box as below.



When you specify a Smart Search and click on **Save,** the new Search line will be added to the display. If your captured data matches these events anywhere in the trace it will display a bar at that location and mark it with a unique number. The trace below has found 480 matches and the display is showing match 1 through 7 on the first line.



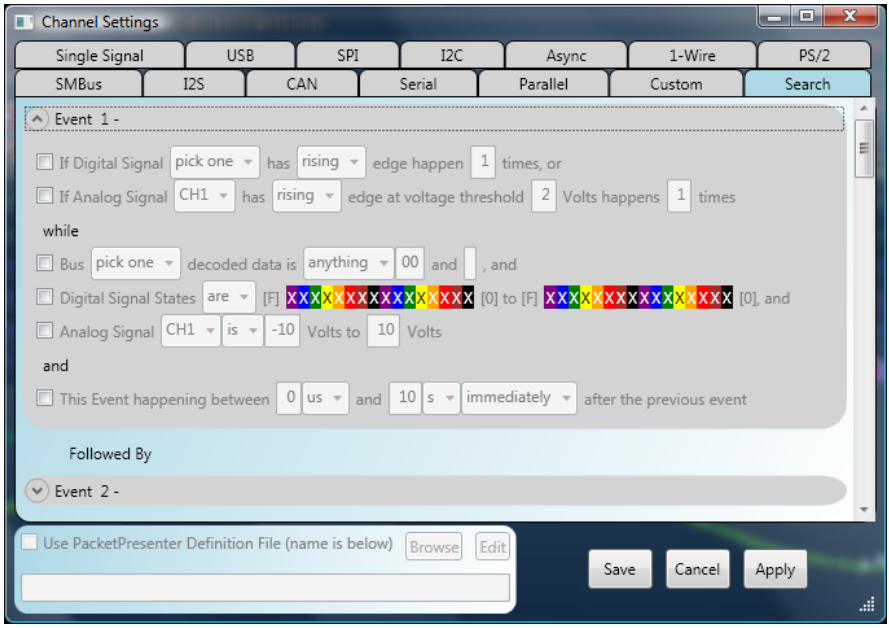
VIEWING SEARCH MATCHES

Once a search has been entered and processed, you can pan through the found matches by using the **left and right arrow buttons** on the search line. You can also see the total number of matches by hovering over the line.

ENTERING A SMART SEARCH

The Smart Search uses the specification that you choose in the channel settings Search window to determine what to highlight on the waveform display.

The search can be made up of up to 32 consecutive **Events**. Each Event is a selection of various bus, analog, and/or digital states. To edit an Event, click on the expander to show the Event details as below.



To enable a line in the Event search, click on the checkbox to the left of the items you want to include in your search.

You can specify any combination of the available lines in a search Event. All search criteria in a single Event must occur simultaneously for an event to be considered a match. For example, if you are looking for an edge on a digital signal, and looking for an analog voltage range, the edge must occur **while** the voltage is inside the range to be considered a match.

The following sections detail the available search items for each event and how they function.

DIGITAL SIGNAL EDGES

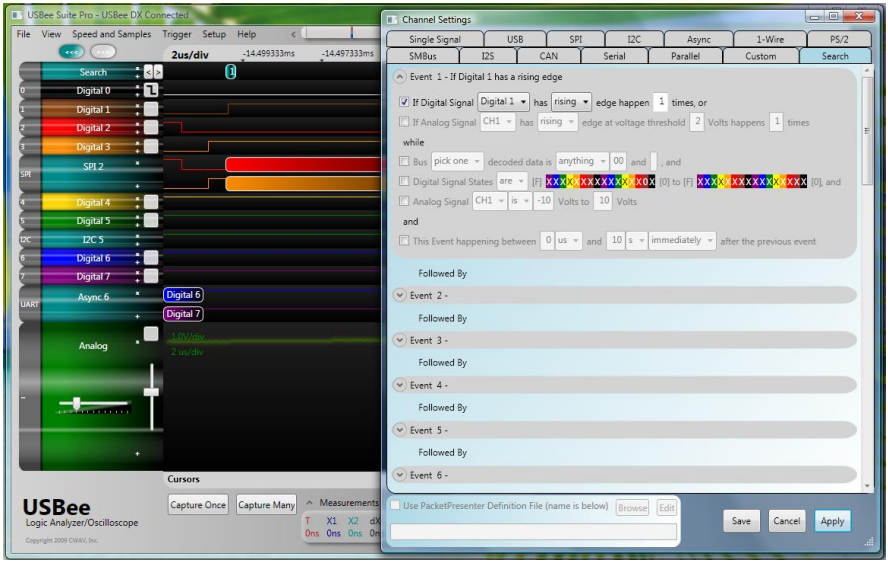
The first line lets you find edges on the digital signals.

First select the Digital line you want to search using the first dropdown box. This box is filled with only the single signals that are displayed on the screen.

Then choose the edge you want to search for: rising, falling or either rising or falling.

Finally, choose how many edges you need to find consecutively. If you want to find areas that have NO edges you can specify 0.

Below shows a search that finds all rising edges of the signal Digital 1.



ANALOG SIGNAL EDGES

The second line lets you find edges on the analog signals, if your USBee has them.

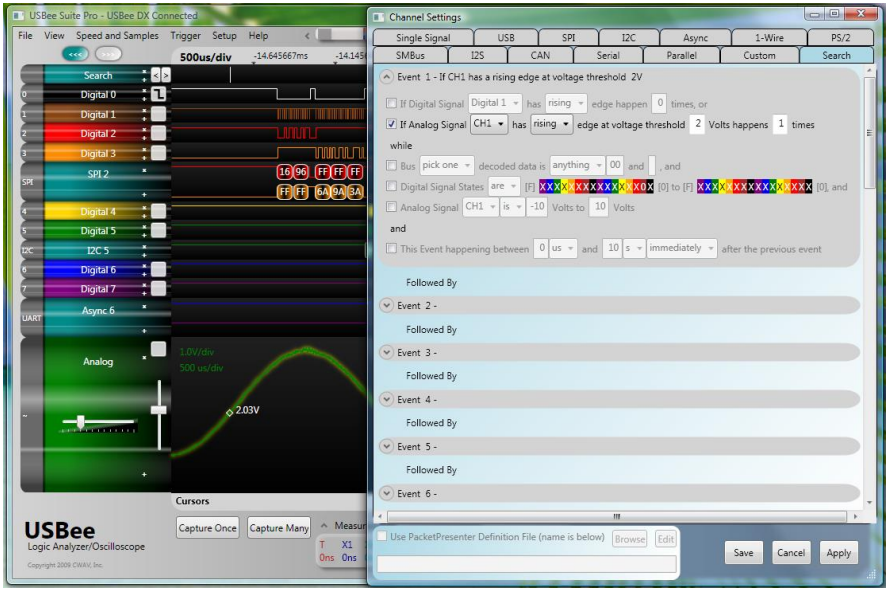
First select the Analog channel you want to search using the first dropdown box.

Then choose the edge you want to search for: rising, falling or either rising or falling.

Next enter the voltage threshold at which you consider the edge occurring. This value can be anywhere between -10 and 10 and can include decimal places.

Finally, choose how many edges you need to find consecutively. If you want to find areas that have NO edges you can specify 0.

Below shows a search that finds all rising edges of the analog signal CH1 with a threshold set at 2.0 Volts. Since the waveform display below is zoomed out the match is shown as simply a line. Zooming in on the search will show the details.



BUS DATA

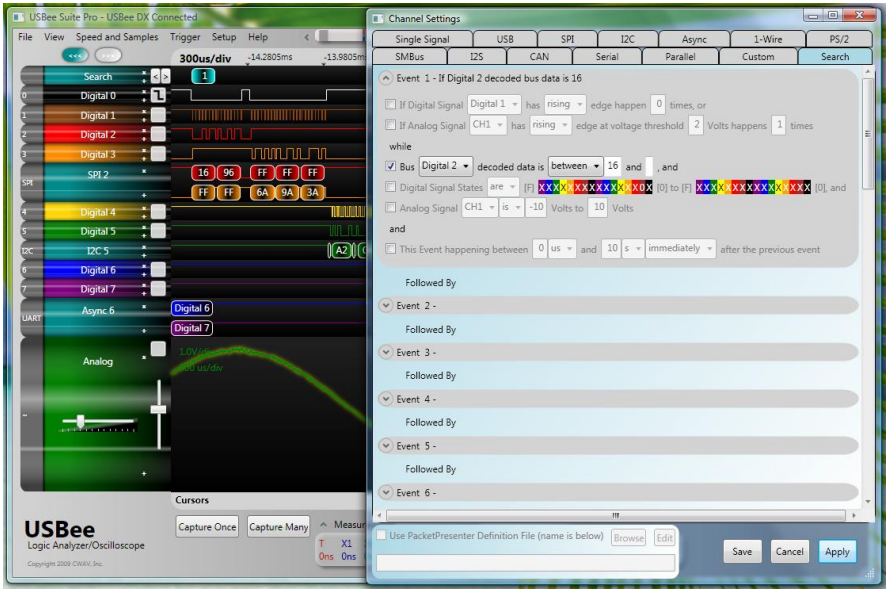
The next line lets you find values of decoded bus data if your waveform display includes them. You can specify specific values to find, values to exclude, or ranges of values.

First select the decoded bus channel you want to search using the first dropdown box.

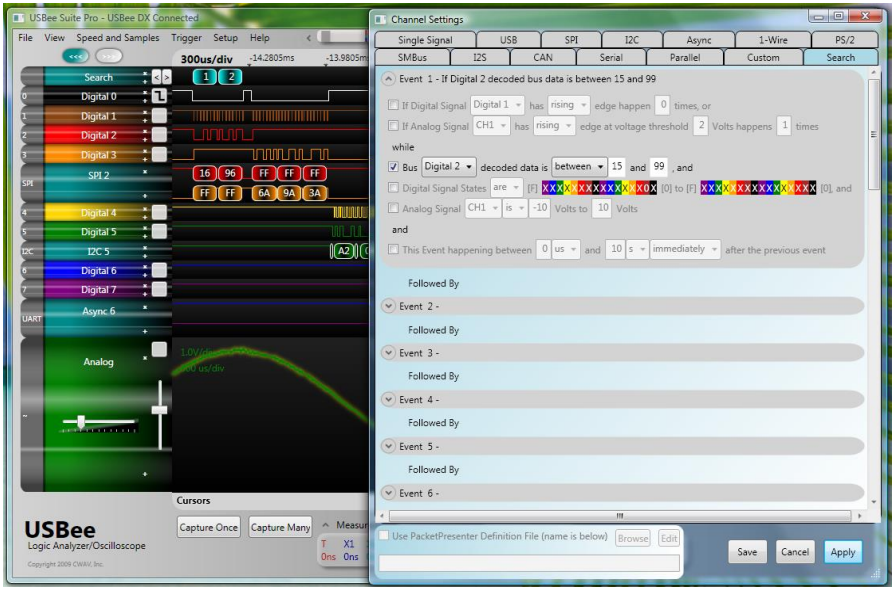
Then choose if you want to find values between (equals) or not between (not equals) the value(s) that follow.

Next enter the actual value of decoded data you are interested in. If it is a single value, leave the second field blank. If you are interested in a range of values, specify the end of the range in the second field.

Below shows a search that finds all decoded data that equals a fixed value of 16.



Below shows a search that finds all decoded data that is between 15 and 99.



DIGITAL SIGNAL STATES AND RANGES

The next line lets you find states, or ranges of states, on the digital signals.

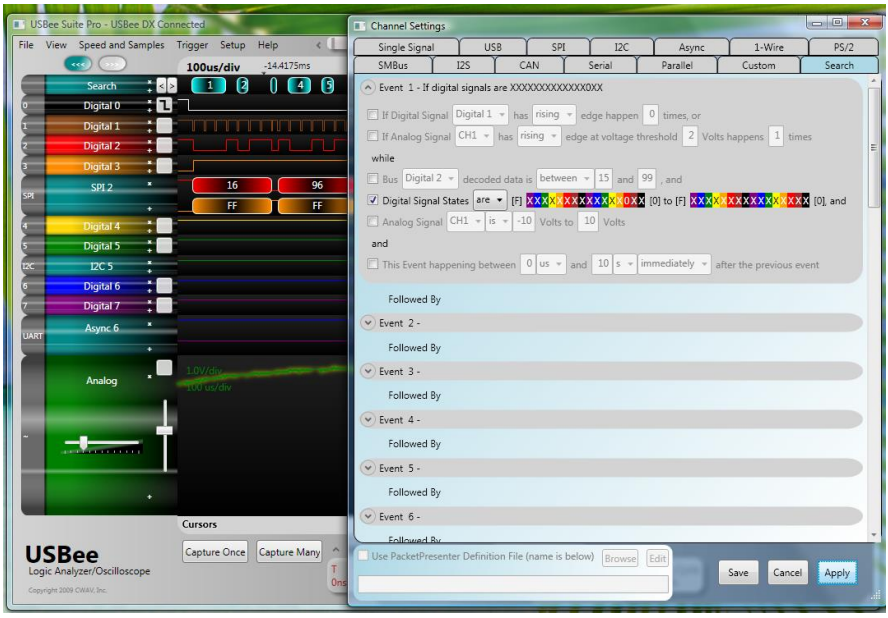
First select if you are looking for the digital states to include the values (**are**), or not include the values (**are not**), that follow.

Then specify the states of all of the digital lines by clicking on each individual signal to change from 0, 1, and X (don't care).

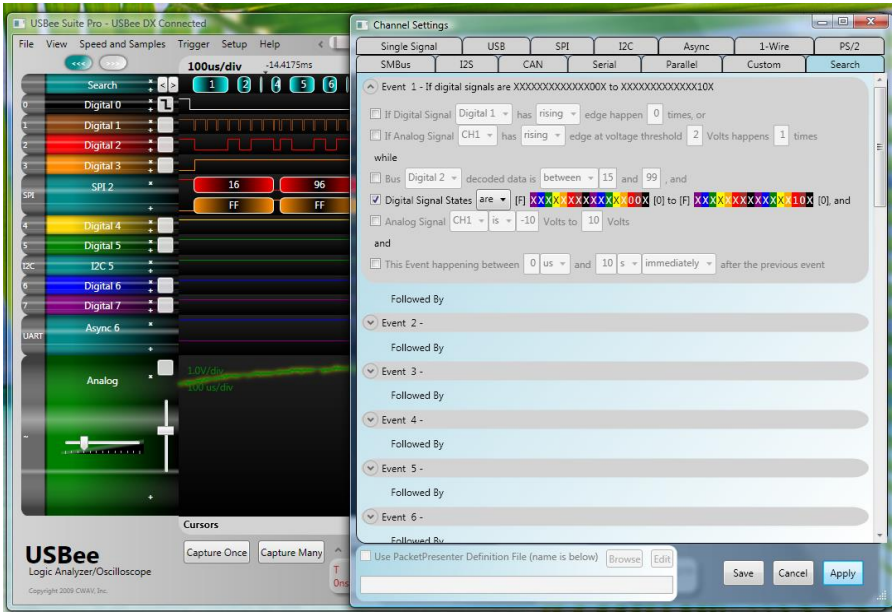
If you are looking for a single set of digital states, leave the second set of signals at all X.

If you want to find a range of states, enter the ending value as the second set of signals. The matched range will then include all values from the first set to the second set, inclusive.

Below shows a search that finds all occurrences of when the Digital 2 signal is logic 0.



Below shows a search that finds all occurrences of when the Digital 2 and Digital 3 signals are 0-0, 0-1, and 1-0. The range starts at the first setting and increments until the second setting.



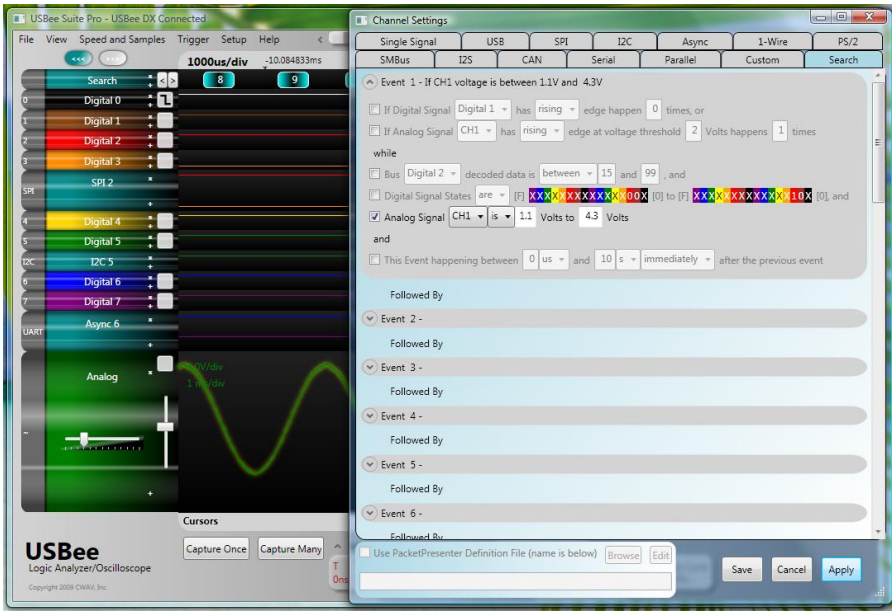
ANALOG SIGNAL STATES AND RANGES

The next line lets you find voltage ranges on the analog signals, if your USBee has them.

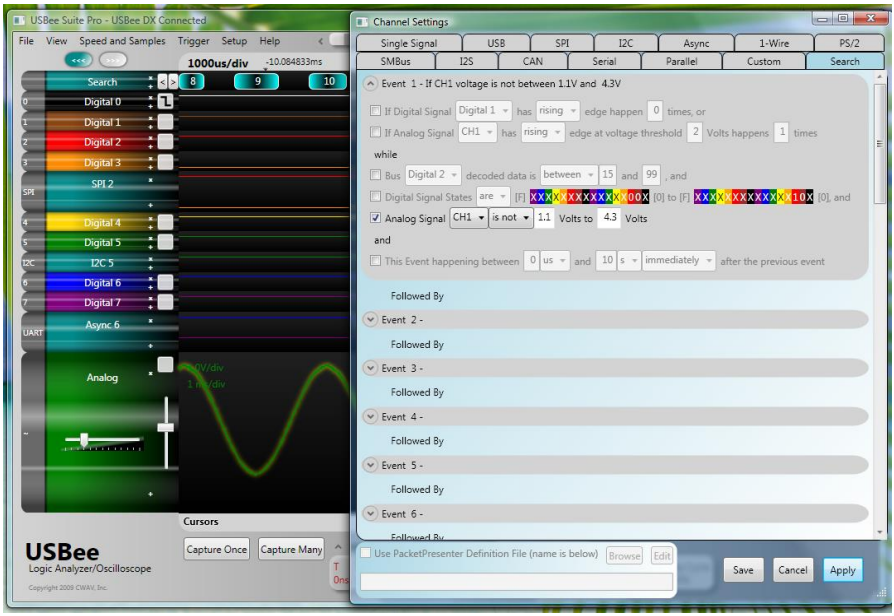
First select if you are looking for the analog voltages to include the values (**is**), or not include the values (**is not**), that follow.

Then specify the voltage range start and end in volts. The matched range will then include all values from the first set to the second set, inclusive.

Below shows a search that finds all times that the analog signal CH1 is between 1.1V and 4.3V.



Below shows a search that finds all times that the analog signal CH1 is NOT between 1.1V and 4.3V.



TIME WINDOW QUALIFIER

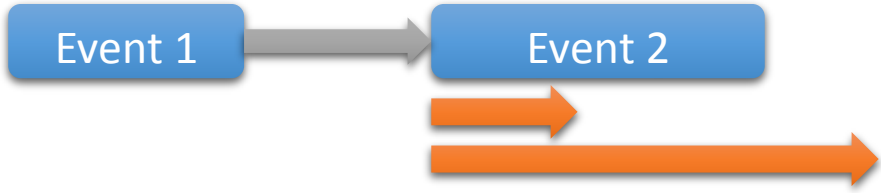
The final line of each Event specifies a time window for the event to occur.

There are two selections to specify a time window: **immediately** or **anytime**.

For the first Event, only **anytime** is available. This specifies a time period in which the entire event must occur for a match to be found. For example, if you want to find when two falling edges occur within 10usecs of each other, specify: *This Event happening between 0s and 10us anytime*.

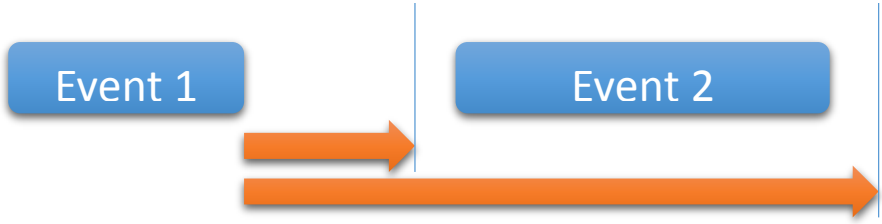
For the Events 2-32, both **anytime** and **immediately** are available.

Anytime specifies a time period minimum and maximum in which the entire event must occur for a match to be found. The match can occur anytime after the previous event, but must occur within the time window. For example, if you want to find when two falling edges occur within 10usecs of each other, specify: *This Event happening between 0s and 10us anytime after the previous event*. Below shows a diagram for the **anytime** setting. As long as Event 2 is at least Minimum and at most Maximum time it is considered a match.

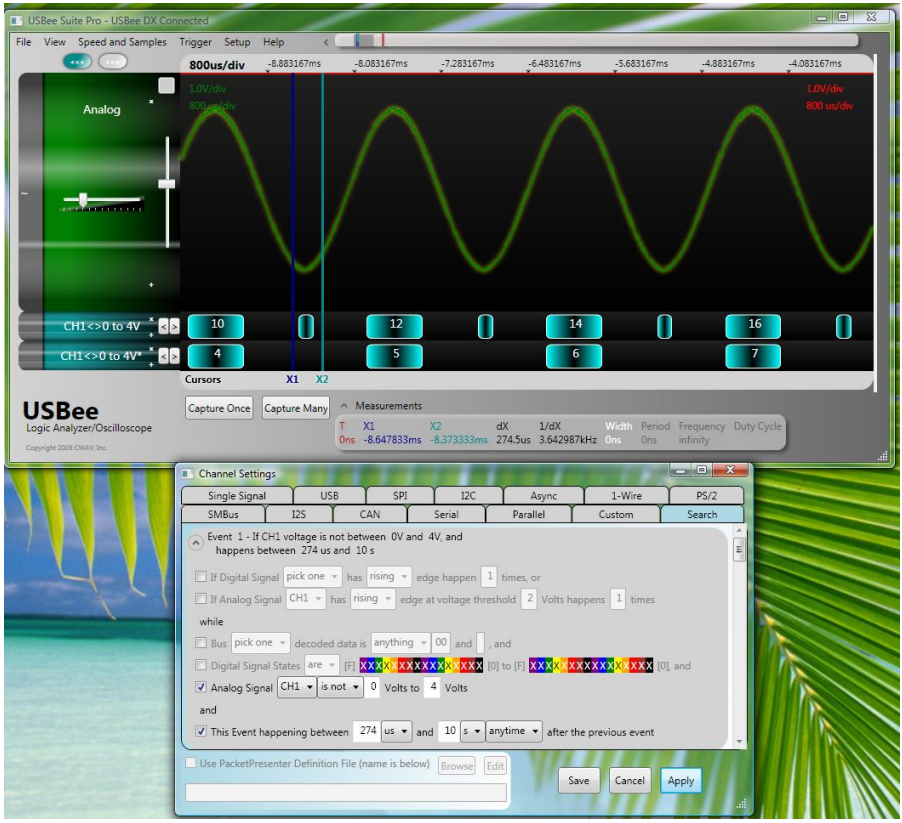


Immediately specifies a time period relative to the end of the previous event in which the entire event must occur for a match to be found. For example, if you want to find when two falling edges occur within 10usecs of each other immediately following the previous event, specify: *This Event happening between 0s and 10us immediately after the previous event*. Below shows a diagram for the **immediately** setting. As long as Event 2 occurs between the Minimum time and the Maximum time it is considered a match.

I

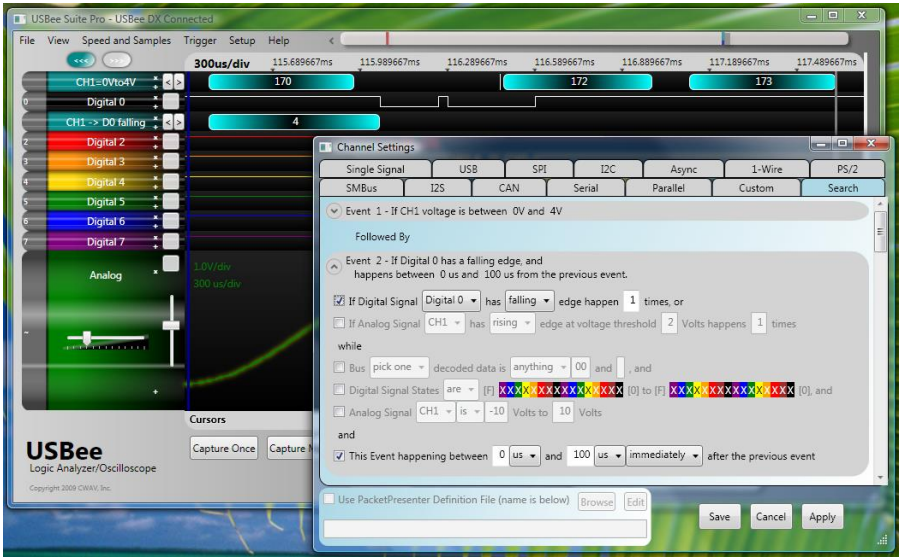


Below shows an example of applying a time window. The first search line shows all occurrences of when the analog CH1 is outside the range 0V to 4V. The second search line is the same criteria with the addition of a time window applied. Only matches that are between 274us and 10seconds are displayed. If you are looking for occurrences that are less than a specific time set the first entry to 0s and the second to the upper limit.


USBee Suite Pro - USBee DX Connected
File View Speed and Samples Trigger Setup Help
800us/div
Analog
1.0V/div
800 us/div
CH1<>0 to 4V
CH1<>0 to 4V*
Cursors
X1 X2
USBee
Logic Analyzer/Oscilloscope
Capture Once
Capture Many
Measurements
Channel Settings
Single Signal USB SPI I2C Async 1-Wire PS/2
SMBus I2S CAN Serial Parallel Custom Search
Event 1 - If CH1 voltage is not between 0V and 4V, and happens between 274 us and 10 s
If Digital Signal pick one has rising edge happen 1 times, or
If Analog Signal CH1 has rising edge at voltage threshold 2 Volts happens 1 times
while
Bus pick one decoded data is anything 00 and , and
Digital Signal States are [F] [0] to [F] [0], and
Analog Signal CH1 is not 0 Volts to 4 Volts
and
This Event happening between 274 us and 10 s anytime after the previous event
Use PacketPresenter Definition File (name is below)
Browse
Edit
Save
Cancel
Apply

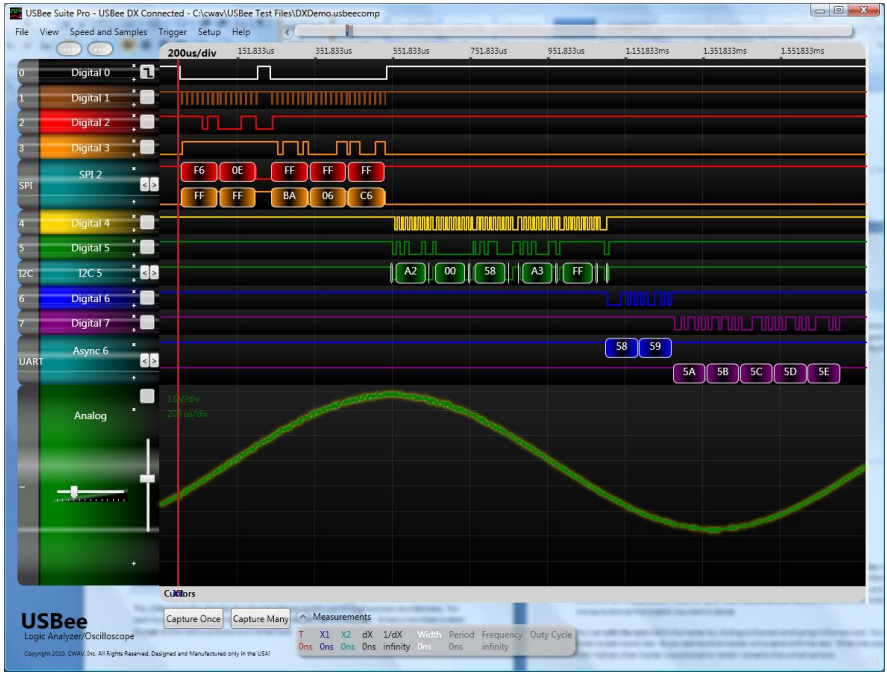
For Events other than the first Event (2-32) you can also specify immediately to indicate that the event must happen between the first time and second time starting at the end of the previous event.

The following example shows two search lines. The first search line shows all occurrences of the CH1 being between 0V and 4V. The second search line shows all occurrences of when the Digital 0 line has a falling edge within 100usecs of the end of the first search.



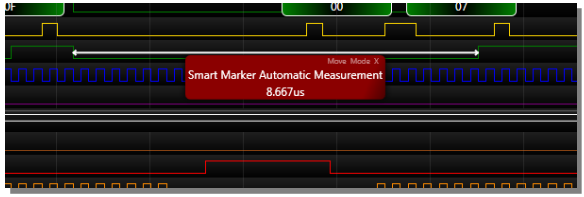
FAST PAN BUS VIEWING

The USBee QX Suite Fast Pan Bus Viewing lets you quickly pan through a busses decoded data. For each bus there is a left and right pan button on the left side of the screen. Simply press these buttons to page to the next or previous bus transactions.

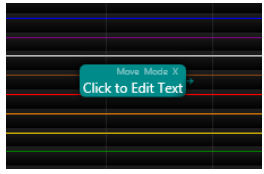


SAMPLE AND SMART MARKERS

Placing markers in your traces can help detail what is happening in your design. There are two types of markers that can be used. The first marker type locks itself to a sample on a waveform and lets you specify the text. The second is a Smart Marker that automatically measures the pulse width, frequency, period or duty cycle of the waveform at the marker location.



SAMPLE MARKERS



Markers that are locked to a specific sample are placed using the **View | Add Sample Marker** menu item. Once you select this menu item your cursor changes to 4-way arrows and a Sample Marker moves wherever you move the cursor. To **place the marker**, position it where you want it and then press the left mouse button. Another faster way to place Sample Markers is to press the middle mouse button at the location you want it placed.

You can **edit the text** within the marker by clicking on the text and typing in the new text. You can hit Enter to add more lines. As you add text the marker will expand to fit the text. When the waveforms then redraw, then marker is positioned to remain locked to the correct sample.

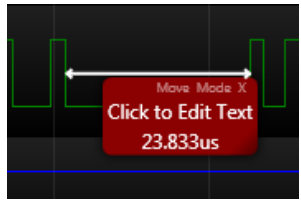
To **move the marker**, click on the Move at the top of the marker. Once you have it moved to the new location use the left mouse button to place it.

The Mode at the top of the marker **changes the direction** of the marker. Click on Mode to change from Left pointing marker to Right pointing marker and vice versa.

To hide all of the markers without deleting them, uncheck the menu item **View | Show Marker Labels**. To turn on the markers, make sure this menu item is checked.

To **delete the marker**, click on the X at the top of the marker. You can delete all markers using the menu item **View | Delete All Markers**. This will delete all Sample Markers and Smart Markers.

SMART MARKERS



Smart Markers are locked to a specific sample and measure the waveform underneath. They are placed using the **View | Add Smart Marker** menu item. Once you select this menu item your cursor changes to 4-way arrows and a Smart Marker moves wherever you move the cursor. To place the marker, position it where you want it and then press the left mouse button.

You can **edit the text** within the marker by clicking on the text and typing in the new text. You can hit Enter to add more lines. As you add text the marker will expand to fit the text. When the waveforms then redraw, then marker is positioned to remain locked to the correct sample.

To **move the marker**, click on the Move at the top of the marker. Once you have it moved to the new location use the left mouse button to place it.

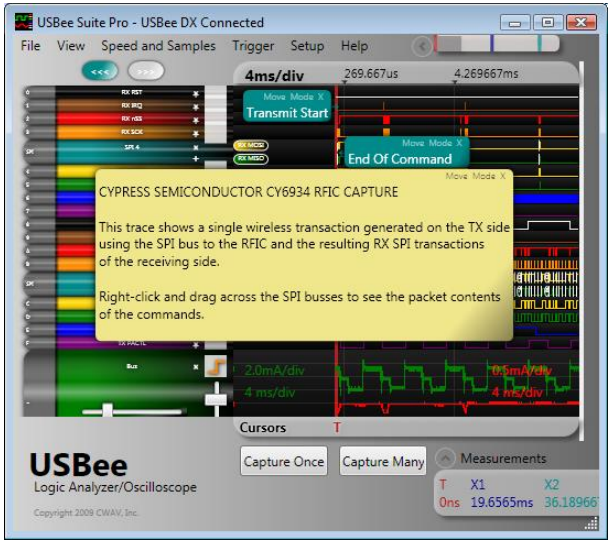
The Mode at the top of the marker **changes the measure mode** of the marker. Click on Mode to cycle through No Measurement, Width, Frequency, Period, and Duty Cycle. An arrow shows the measured area and the measurement shows up as the last line of the marker.

To hide all of the markers without deleting them, uncheck the menu item **View | Show Marker Labels**. To turn on the markers, make sure this menu item is checked.

To **delete the marker**, click on the X at the top of the marker. You can delete all markers using the menu item **View | Delete All Markers**. This will delete all Sample Markers and Smart Markers.

ANNOTATIONS AND STICKY NOTES

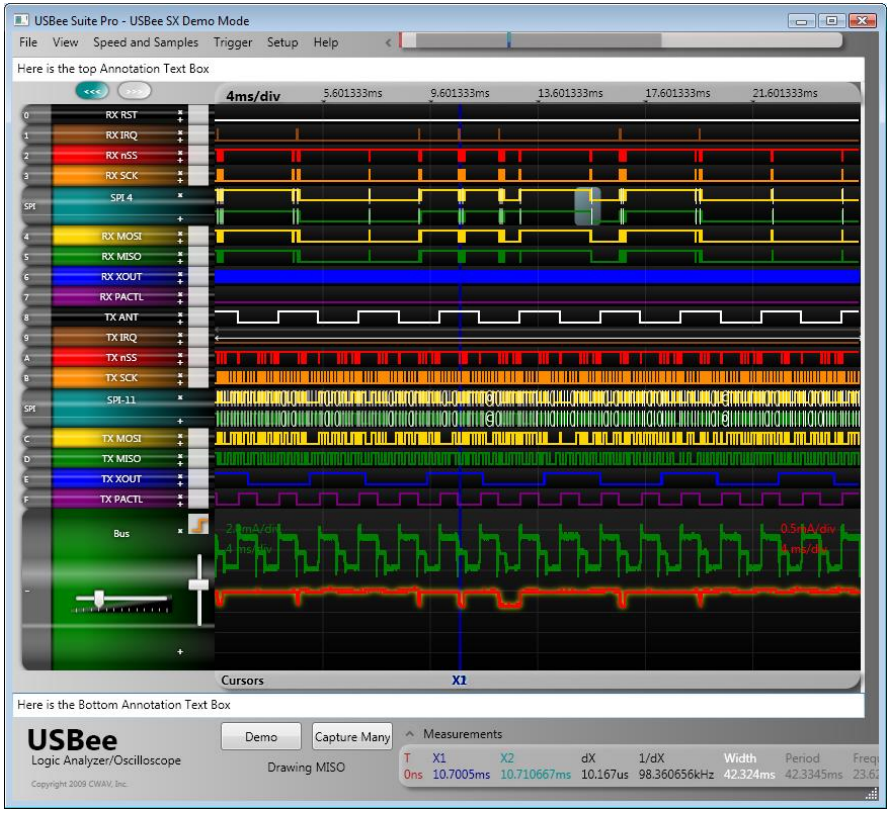
The USBee QX Suite adds Sticky Notes which you can use to further detail your traces for documentation purposes. You can also add Title and Footer text to your display that is saved with the trace file.


USBee Suite Pro - USBee DX Connected
File View Speed and Samples Trigger Setup Help
4ms/div
269.667us
4.269667ms
Transmit Start
End Of Command
CYPRESS SEMICONDUCTOR CY6934 RFIC CAPTURE
This trace shows a single wireless transaction generated on the TX side using the SPI bus to the RFIC and the resulting RX SPI transactions of the receiving side.
Right-click and drag across the SPI busses to see the packet contents of the commands.
2.0mA/div
4 ms/div
0.5mA/div
4 ms/div
Cursors
T
USBee
Logic Analyzer/Oscilloscope
Capture Once
Capture Many
Measurements
T X1 X2
0ns 19.6565ms 36.18966
Copyright 2009 CWAV, Inc.

ANNOTATIONS

Annotation Text Boxes are editable text blocks that are located at the Top and Bottom of the USBee QX Suite window. Annotation Text Boxes are enabled and disabled using the **View | Annotation Text Boxes** menu item.

To edit the text, simply select the box and edit the text. This text is then saved with your capture files.



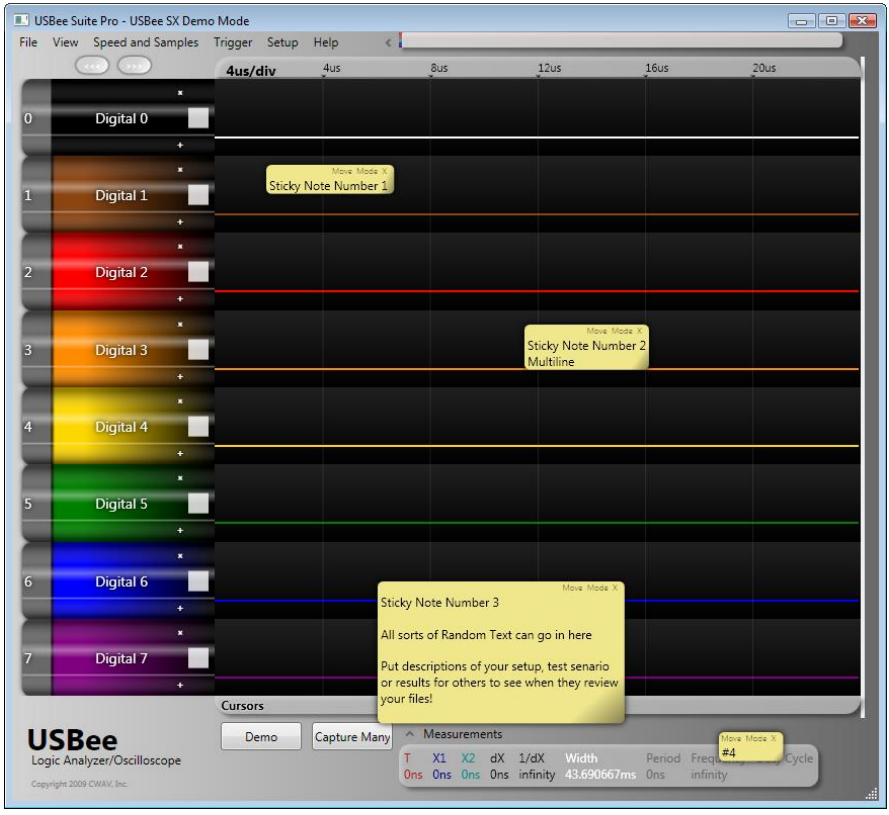
STICKY NOTES

Sticky Notes are editable text blocks that look like sticky notes. They can be positioned anywhere in the application window. Sticky Notes are placed using the **View | Add Sticky Note** menu item. Once you select this menu item your cursor changes to 4-way arrows and a Sticky Note moves wherever you move the cursor. To place the note, position it where you want it and then press the left mouse button.

You can **edit the text** within the Sticky Note by clicking on the text and typing in the new text. You can hit Enter to add more lines. As you add text the marker will expand to fit the text.

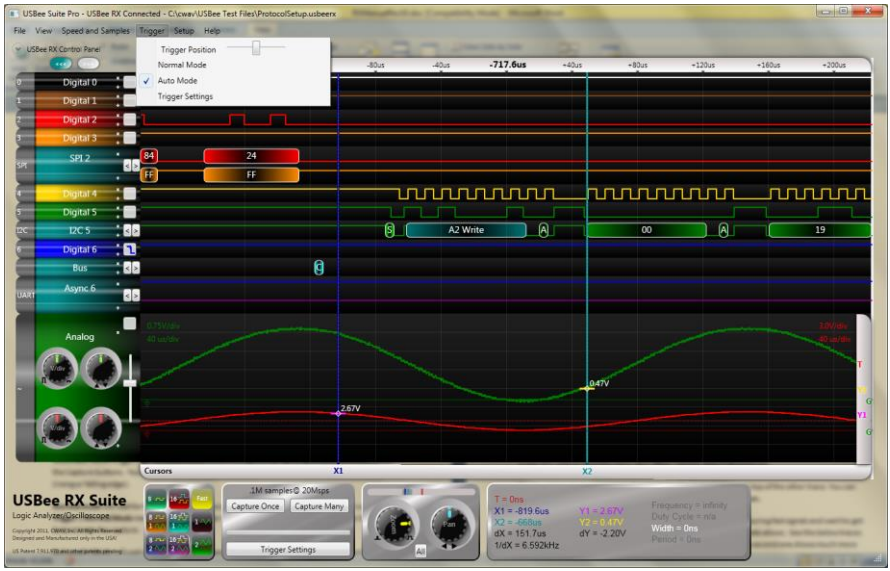
To **move the Sticky Note**, click on the Move at the top of the note. Once you have it moved to the new location use the left mouse button to place it.

To **delete the Sticky Note**, click on the X at the top of the note. You can delete all Sticky Notes using the menu item **View | Delete All Sticky Notes**.



ACQUISITION CONTROL

The USBee QX Suite adds more trace acquisition and triggering controls such as Normal Mode, Automatic Mode, Single Capture and Multiple Capture.



When the USBee QX Suite is first started, no acquisition is taking place. You need to press one of the acquisition buttons, **Capture Once** or **Capture Many**, at the bottom of the window to capture data.

The **Capture Many** button performs an infinite series of traces, one after the other. This lets you see frequent updates of what the actual signals are doing in real time. If you would like to stop the updating, just press the same button again (now reading Stop) and the updating will stop. This mode is great for signals that repeat over time.

The **Capture Once** button captures a single trace and stops. This mode is good for detailed analysis of a single event, rather than one that occurs repeatedly.

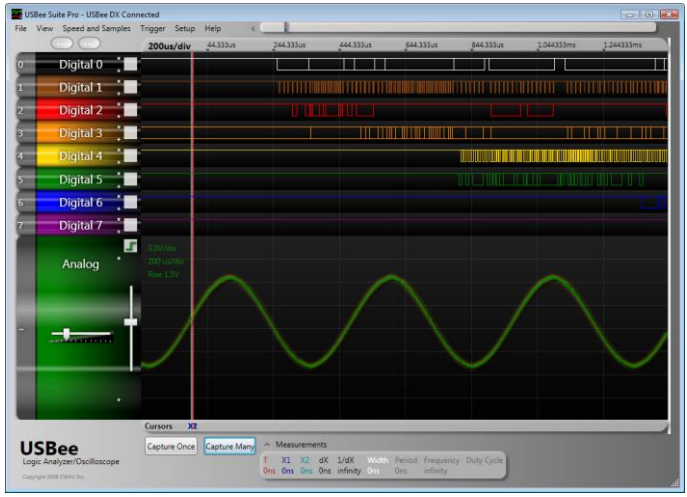
The USBee QX Suite adds the ability to have either Normal Mode (default in the Standard version) or Automatic Mode triggering. This determines when the signals start getting sampled once you press the Capture buttons. You specify the trigger event by selecting one of the USBee signals to trigger on (rising or falling edge).

Normal mode will wait for the trigger event to occur before capturing. Select this option using the **Trigger | Normal Mode** menu item. If the trigger event does not occur you can press the Stop button to terminate the capture.

Automatic Mode will wait a set time for the trigger and will automatically trigger if it is not found. Select this option using the **Trigger | Automatic Mode** menu item. If the trigger event does not occur within a specified time, it will automatically start a capture of whatever is on the signals at the time. You can press the Stop button to terminate the capture.

DISPLAY MODES

The USBee QX Suite lets you widen the trace waveforms, display the analog waveforms as vectors or single sample points, and persist the display from one trace to the next.

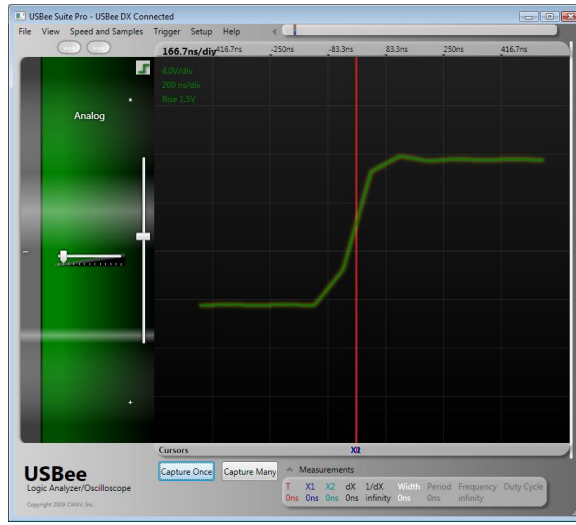


The **Wide** setting shows the waves using a wider pixel setting. This makes the waves easier to see. You can toggle this setting using the menu item **View | Wide Lines.**

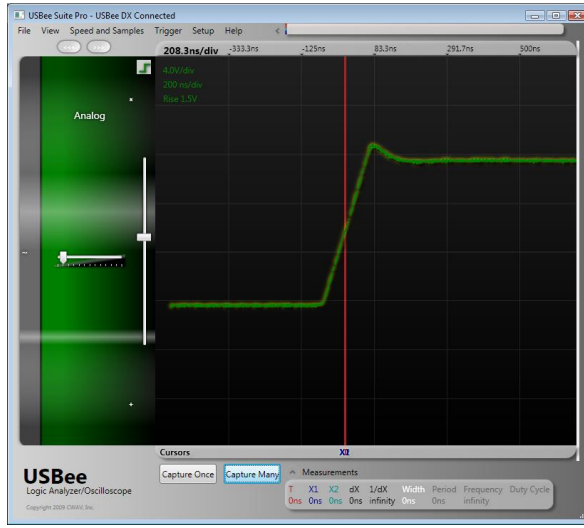
The **Vectors** setting draws the waveforms as a line between adjacent samples. With this mode turned off, the samples are shown simply as dots on the display at the sample position. You can toggle this setting using the menu item **View | Vector-based Waveforms.**

The **Persist** mode does not clear the display and writes one trace on top of the other trace. You can toggle this setting using the menu item **View | Waveform Persistence.**

The benefits of these display modes can be seen when you are measuring fast signals and want to get more resolution out of the oscilloscope than the maximum sample rate allows. See the below traces to see the difference. Each trace is taken of the same signal, but the second one shows much more wave detail over a short time of display updates.



Persist = OFF, Vectors = ON, Wide = ON



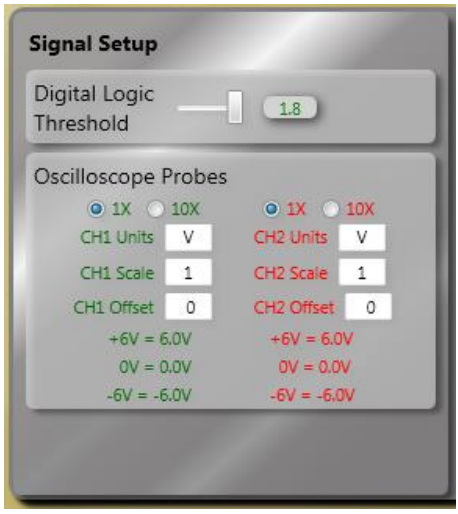
Persist = ON, Vectors = OFF, Wide = ON

ANALOG CHANNELS SCALING

The USBee QX Suite provides a scaling ability to convert the analog voltages into other units of measurement.

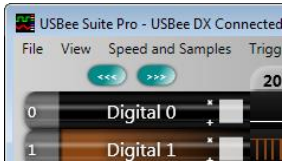
By default, each analog channel is set to display the measurements in Volts where 1V is shown as 1V on the display. Sometimes the measurement might actually mean a different thing than voltage. The menu item **Setup | Analog Channel Settings** lets you specify the units of measurement as well as a scale factor.

Below shows the default setting for the analog channels showing a gain value of 1, offset of 0 and units of Volts.



BROWSER-LIKE NAVIGATION

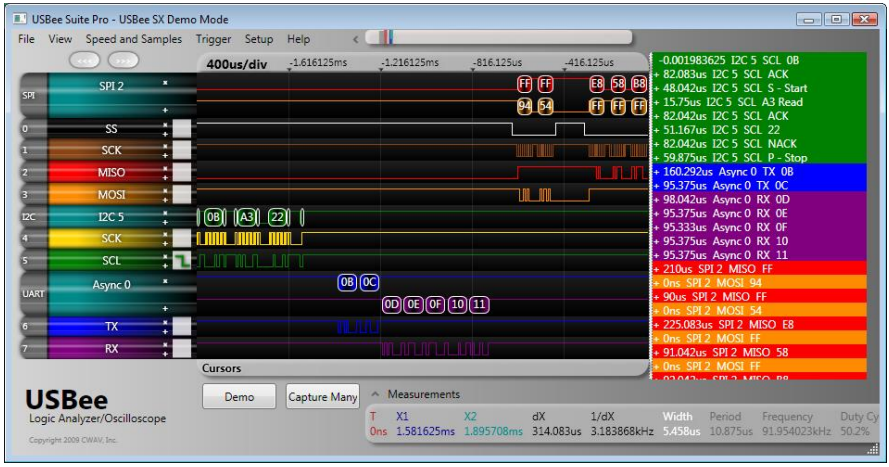
The USBee QX Suite adds browser-like Forward and Back buttons that let you quickly navigate through your trace display.



Each time you stop at a certain point when viewing your waveforms, the location is saved to the history buffer. This allows you to quickly jump back to the previous locations within your trace without having to scroll, pan or zoom. Press the Back Button (Cyan oval with <<<) to go backwards in the history buffer. Press the Forward Button (Cyan oval with >>>) to go forward in the history buffer.

RELATIVE TIME DECODE

The USBee QX Suite also adds a Relative Time or Absolute Time setting for the decoded data lists.



Absolute Timestamps display the sample time for each decoded bus transaction relative to the trigger location. You can turn on Absolute Timestamps using the menu item **View | Decoder Timestamps Absolute**.

```
0.017596417,SPI 2,MISO,4A
0.017596417,SPI 2,MOSI,FF
0.017688458,SPI 2,MISO,AA
0.017688458,SPI 2,MOSI,FF
0.017802750,I2C 5,SCL,S - Start
0.017818458,I2C 5,SCL,A2 Write
0.017900542,I2C 5,SCL,ACK
0.017933167,I2C 5,SCL,00
0.018015250,I2C 5,SCL,ACK
0.018049208,I2C 5,SCL,4A
0.018131292,I2C 5,SCL,ACK
0.018179375,I2C 5,SCL,S - Start
0.018195083,I2C 5,SCL,A3 Read
0.018277167,I2C 5,SCL,ACK
0.018328333,I2C 5,SCL,61
0.018410417,I2C 5,SCL,NACK
0.018470208,I2C 5,SCL,P - Stop
0.018633208,Async 0,TX,4A
0.018728542,Async 0,TX,4B
0.018826583,Async 0,QX,4C
0.018921958,Async 0,QX,4D
0.019017333,Async 0,QX,4E
0.019112708,Async 0,QX,4F
0.019208042,Async 0,QX,50
0.019417042,SPI 2,MISO,FF
0.019417042,SPI 2,MOSI,16
0.019509083,SPI 2,MISO,FF
0.019509083,SPI 2,MOSI,96
0.019733167,SPI 2,MISO,6A
```

Relative Timestamps display the time difference since the last bus transaction and the current transaction. You can turn on Relative Timestamps using the menu item **View | Decoder Timestamps Relative**.

```
+82.042us,I2C 5,SCL,ACK
+51.167us,I2C 5,SCL,22
+82.042us,I2C 5,SCL,NACK
+59.875us,I2C 5,SCL,P - Stop
+160.292us,Async 0,TX,0B
+95.375us,Async 0,TX,0C
+98.042us,Async 0,QX,0D
+95.375us,Async 0,QX,0E
+95.333us,Async 0,QX,0F
+95.375us,Async 0,QX,10
+95.375us,Async 0,QX,11
+210us,SPI 2,MISO,FF
+0ns,SPI 2,MOSI,94
+90us,SPI 2,MISO,FF
+0ns,SPI 2,MOSI,54
+225.083us,SPI 2,MISO,E8
+0ns,SPI 2,MOSI,FF
+91.042us,SPI 2,MISO,58
+0ns,SPI 2,MOSI,FF
+92.042us,SPI 2,MISO,B8
+0ns,SPI 2,MOSI,FF
+114.292us,I2C 5,SCL,S - Start
+15.708us,I2C 5,SCL,A2 Write
+82.083us,I2C 5,SCL,ACK
+32.667us,I2C 5,SCL,00
+82.042us,I2C 5,SCL,ACK
+33.958us,I2C 5,SCL,12
+82.042us,I2C 5,SCL,ACK
+48.083us,I2C 5,SCL,S - Start
+15.708us,I2C 5,SCL,A3 Read
+82.083us,I2C 5,SCL,ACK
+51.167us,I2C 5,SCL,29
```

PACKETPRESENTER™

The USBee QX Suite adds the PacketPresenter™ feature that runs alongside of the existing bus decoders. The PacketPresenter™ takes the output of raw binary data from the bus decoders and parses the stream according to users PacketPresenter Definition File for the intent of displaying the communications in easily understood graphical displays.

OVERVIEW

Using the USBee QX Suite application, it is normal for users to debug communication that is being transmitted between ICs or system components. This debugging can be performed by viewing the waveforms on the screen, or by viewing decoded bus traffic for the various types of busses. For example users can see the voltage versus time waveforms of an ASYNC bus Tx and Rx lines, or decode the waveform into a byte stream using the standard bus definition (ASYNC for example) that is then displayed in text in-line with the waveform.

The PacketPresenter™ feature runs alongside of the existing bus decoders of the USBee QX Suite. The PacketPresenter™ takes the output of raw binary data from the bus decoder and parses the stream according to users PacketPresenter Definition File for the intent of displaying the communications in easily understood graphical displays. The resulting packets are then displayed in a window below the waveforms.

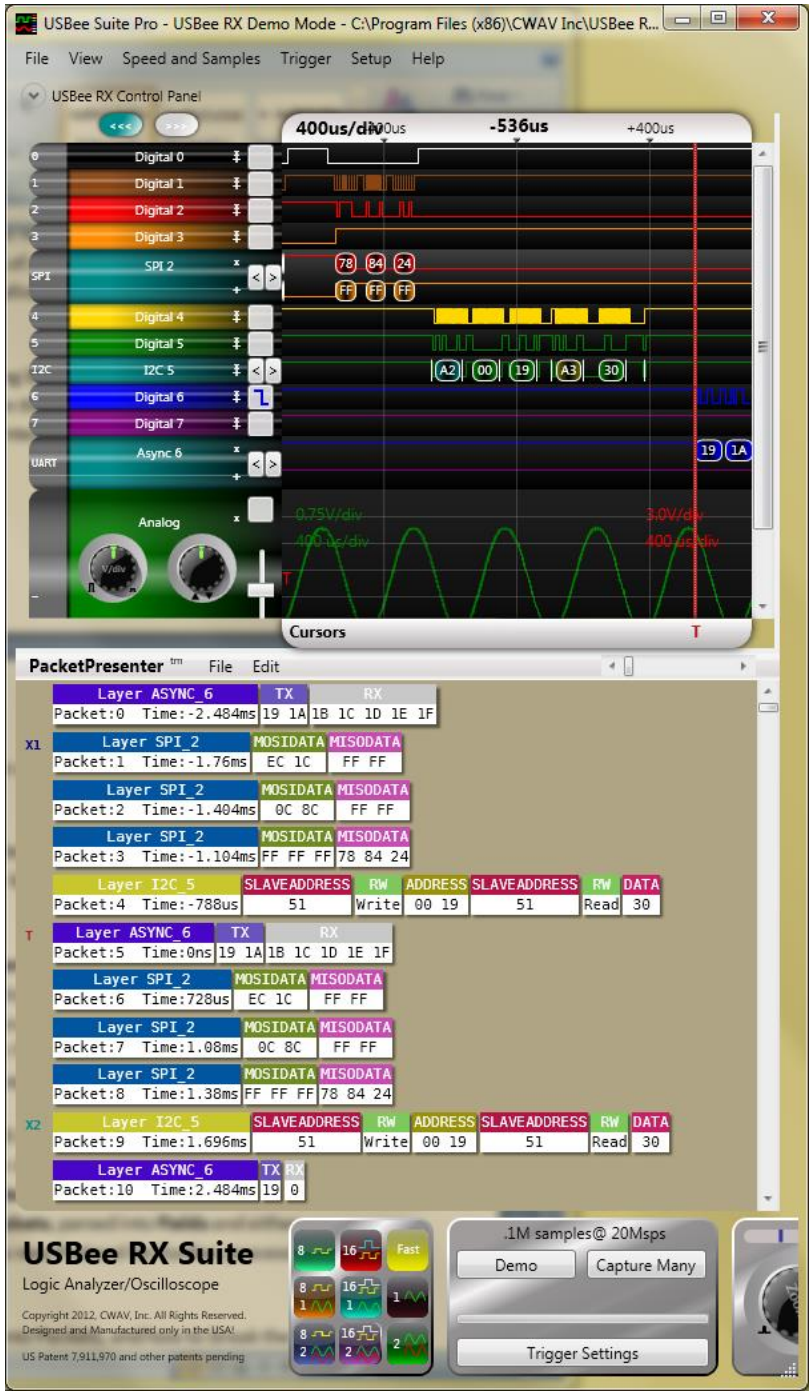
To **Show the PacketPresenter** window, choose the menu item View | Show PacketPresenter Window. To resize the window, click and drag the thin bar between the PacketPresenter window and the waveforms.

Protocols are defined using a text file, called a **PacketPresenter Definition File**, which specifies the fields within the protocol and how to display that information on the screen. It is intended to be generic enough that customers can create their own protocol decoders for their own custom bus types. Initially, all bus types use a generic PacketPresenter file to display the bus data for that bus. You can then create and customize your own PacketPresenter file for any bus.

It is assumed that each **PacketPresenter Definition File** will correspond to one single bus type, and that the incoming bytes from that bus will be inputs for the decoding process. This steam of data is called an incoming **Data Stream** and it is handled by a **Protocol Processor**. Each Protocol Processor takes a single incoming Data Stream that is broken into **Packets**, parsed into **Fields** and either displayed as a field on the screen, ignored, and/or sent to a new Protocol for further processing (as in an N layer protocol).

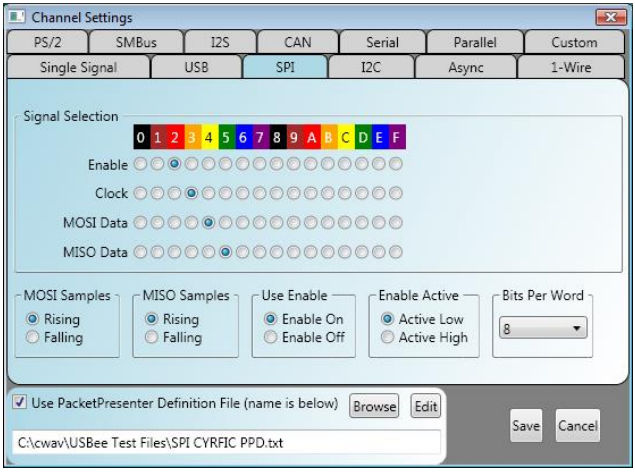
Each Protocol Processor defines how to break the stream into Packets, and how to break the Packets into Fields. These Fields can then be displayed or sent to another Data Stream for further processing.

Below shows a sample PacketPresenter output screen.


USBee Suite Pro - USBee RX Demo Mode - C:\Program Files (x86)\CWAV Inc\USBee R...
File View Speed and Samples Trigger Setup Help
USBee RX Control Panel
400us/div -536us +400us
Digital 0
Digital 1
Digital 2
Digital 3
SPI 2
Digital 4
Digital 5
I2C 5
Digital 6
Digital 7
Async 6
Analog
Cursors
PacketPresenter File Edit
Layer ASYNC_6 TX RX
Packet:0 Time:-2.484ms 19 1A 1B 1C 1D 1E 1F
Layer SPI_2 MOSIDATA MISODATA
Packet:1 Time:-1.76ms EC 1C FF FF
Packet:2 Time:-1.404ms 0C 8C FF FF
Packet:3 Time:-1.104ms FF FF FF 78 84 24
Layer I2C_5 SLAVEADDRESS RW ADDRESS SLAVEADDRESS RW DATA
Packet:4 Time:-788us 51 Write 00 19 51 Read 30
Packet:5 Time:0ns 19 1A 1B 1C 1D 1E 1F
Packet:6 Time:728us EC 1C FF FF
Packet:7 Time:1.08ms 0C 8C FF FF
Packet:8 Time:1.38ms FF FF FF 78 84 24
Packet:9 Time:1.696ms 51 Write 00 19 51 Read 30
Packet:10 Time:2.484ms 19 0
USBee RX Suite
Logic Analyzer/Oscilloscope
Copyright 2012, CWAV, Inc. All Rights Reserved.
Designed and Manufactured only in the USA!
US Patent 7,911,970 and other patents pending
Fast
.1M samples@ 20Msps
Demo
Capture Many
Trigger Settings

SETTING UP THE PACKETPRESENTER

Each digital waveform on the screen can be defined as a different bus (I2C, SPI, etc.) in the Channel settings dialog box by clicking on the white box to the left of the signal name. Below shows the Channel Settings dialog box.



All busses will use a default PacketPresenter internal file to display the bus data until a custom file is defined by the user.

To enable a custom PacketPresenter file for this channel, check the "**Use PacketPresenter definition file (name is below)**" checkbox. Then choose the PacketPresenter definition file by clicking the **Browse** button to the right. Once you choose the file, you can edit the contents by clicking the "Edit File" button.

Once the PacketPresenter is enabled all bus decodes will be processed through the PacketPresenter as well as the original bus decoder.

VIEWING THE PACKETPRESENTER OUTPUT

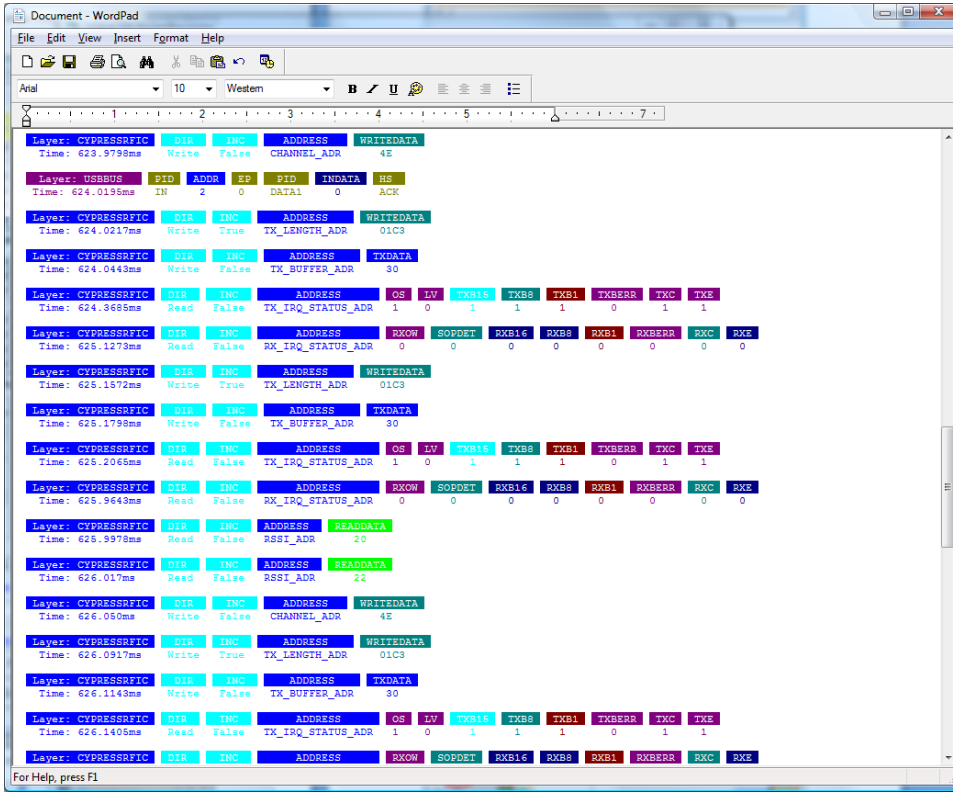
The PacketPresenter output is shown in a window below the waveform screen. This window can be shown using the menu item View | Show PacketPresenter Window, or by clicking and dragging the thin bar between the waveform and PacketPresenter window.

SAVING PACKETPRESENTER DATA TO TEXT OR RTF FILES

The PacketPresenter output can be saved to either a Text file or an RTF file (Rich Text Format). The text file output is a textual representation of the packets as seen below. Access these features through the **File |Save As Text** or **File | Save As RTF** menu items.

```
Layer: CYPRESSRFIC   DIR      INC       ADDRESS      READDATA
 Time: 615.2797ms    Read    False    CHANNEL_ADR       0

 Layer: USBBUS      PID   ADDR   EP    PID            INDATA            HS
Time: 616.0198ms    IN      2     0    DATA0   22 2A 00 07 05 81 03 08   ACK

 Layer: USBBUS      PID   ADDR   EP    PID            INDATA            HS
Time: 617.0197ms    IN      2     0    DATA1   00 0A 09 04 01 00 01 03   ACK

 Layer: USBBUS      PID   ADDR   EP    PID            INDATA            HS
Time: 618.0197ms    IN      2     0    DATA0   01 02 00 09 21 11 01 00   ACK

 Layer: USBBUS      PID   ADDR   EP    PID            INDATA            HS
Time: 619.0197ms    IN      2     0    DATA1   01 22 D1 00 07 05 82 03   ACK

 Layer: USBBUS      PID   ADDR   EP    PID    INDATA    HS
Time: 620.0197ms    IN      2     0    DATA0   0A0008    ACK
```

Saving data to an RTF file format saves the graphical nature of the packets and can be read by many word processing programs, such as Microsoft Word and WordPad. Below is a screenshot of data saved to an RFT file and viewed using WordPad.


Document - WordPad
File Edit View Insert Format Help
Arial 10 Western
Layer: CYPRESSRFIC DIR INC ADDRESS WRITEDATA
Time: 623.9798ms Write False CHANNEL_ADR 4E
Layer: USBBUS PID ADDR EP PID INDATA HS
Time: 624.0195ms IN 2 0 DATA1 0 ACK
Layer: CYPRESSRFIC DIR INC ADDRESS WRITEDATA
Time: 624.0217ms Write True TX_LENGTH_ADR 01C3
Layer: CYPRESSRFIC DIR INC ADDRESS TXDATA
Time: 624.0443ms Write False TX_BUFFER_ADR 30
Layer: CYPRESSRFIC DIR INC ADDRESS OS LV TXB15 TXB8 TXB1 TXBERR TXC TXE
Time: 624.3685ms Read False TX_IRQ_STATUS_ADR 1 0 1 1 1 0 1 1
Layer: CYPRESSRFIC DIR INC ADDRESS RXOW SOPDET RXB16 RXB8 RXB1 RXBERR RXC RXE
Time: 625.1273ms Read False RX_IRQ_STATUS_ADR 0 0 0 0 0 0 0 0
Layer: CYPRESSRFIC DIR INC ADDRESS WRITEDATA
Time: 625.1572ms Write True TX_LENGTH_ADR 01C3
Layer: CYPRESSRFIC DIR INC ADDRESS TXDATA
Time: 625.1798ms Write False TX_BUFFER_ADR 30
Layer: CYPRESSRFIC DIR INC ADDRESS OS LV TXB15 TXB8 TXB1 TXBERR TXC TXE
Time: 625.2065ms Read False TX_IRQ_STATUS_ADR 1 0 1 1 1 0 1 1
Layer: CYPRESSRFIC DIR INC ADDRESS RXOW SOPDET RXB16 RXB8 RXB1 RXBERR RXC RXE
Time: 625.9643ms Read False RX_IRQ_STATUS_ADR 0 0 0 0 0 0 0 0
Layer: CYPRESSRFIC DIR INC ADDRESS READDATA
Time: 625.9978ms Read False RSSI_ADR 20
Layer: CYPRESSRFIC DIR INC ADDRESS READDATA
Time: 626.017ms Read False RSSI_ADR 22
Layer: CYPRESSRFIC DIR INC ADDRESS WRITEDATA
Time: 626.050ms Write False CHANNEL_ADR 4E
Layer: CYPRESSRFIC DIR INC ADDRESS WRITEDATA
Time: 626.0917ms Write True TX_LENGTH_ADR 01C3
Layer: CYPRESSRFIC DIR INC ADDRESS TXDATA
Time: 626.1143ms Write False TX_BUFFER_ADR 30
Layer: CYPRESSRFIC DIR INC ADDRESS OS LV TXB15 TXB8 TXB1 TXBERR TXC TXE
Time: 626.1405ms Read False TX_IRQ_STATUS_ADR 1 0 1 1 1 0 1 1
Layer: CYPRESSRFIC DIR INC ADDRESS RXOW SOPDET RXB16 RXB8 RXB1 RXBERR RXC RXE
For Help, press F1

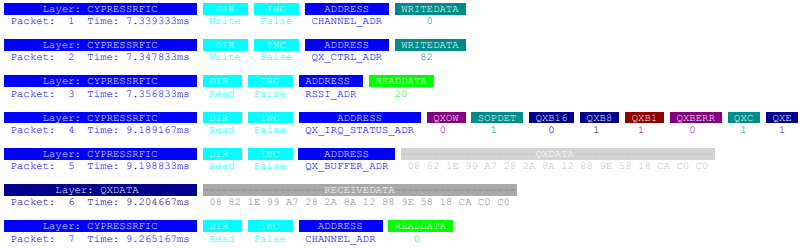
In order to maintain correct position of the graphical portions of the RTF file, all spaces are converted to the character "~" and set to the background color. Viewed or printed in the RTF format will look correct as above. If you copy only the text of this output, you will want to search and replace every "~" with a space.

COPYING PACKETPRESENTER OUTPUT TO OTHER PROGRAMS

You can copy the contents of the PacketPresenter output window to other programs in a number of ways.

First, you can copy the screenshot of the window by selecting the window and pressing Alt-PrtScr on your keyboard. This copies the image of the window to the Windows clipboard and you can paste that image into any program that accepts images.

You can also use the **Edit | Copy as Text** or **Edit | Copy as RTF** menu items. All packets are copied to the clipboard in the format specified. Below is a sample of packets copied in RTF format and pasted into Word.

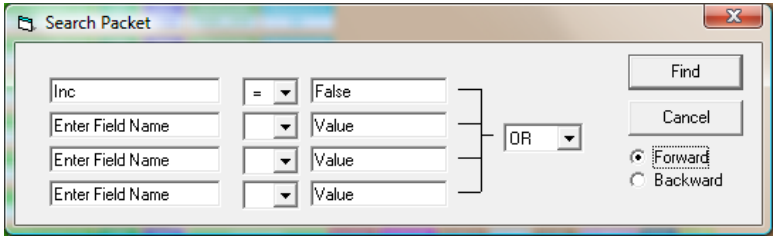

Layer: CYPRESSRFIC DIR INC ADDRESS WRITEDATA
Packet: 1 Time: 7.339333ms Write False CHANNEL_ADR 0
Layer: CYPRESSRFIC DIR INC ADDRESS WRITEDATA
Packet: 2 Time: 7.347833ms Write False QX_CTRL_ADR 82
Layer: CYPRESSRFIC DIR INC ADDRESS READDATA
Packet: 3 Time: 7.356833ms Read False RSSI_ADR 20
Layer: CYPRESSRFIC DIR INC ADDRESS QXOW SOPDET QXB16 QXB8 QXB1 QXBERR QXC QXE
Packet: 4 Time: 9.189167ms Read False QX_IRQ_STATUS_ADR 0 1 0 1 1 0 1 1
Layer: CYPRESSRFIC DIR INC ADDRESS QXDATA
Packet: 5 Time: 9.198833ms Read False QX_BUFFER_ADR 08 82 1E 99 A7 28 2A 8A 12 88 9E 58 18 CA C0 C0
Layer: QXDATA RECEIVEDATA
Packet: 6 Time: 9.204667ms 08 82 1E 99 A7 28 2A 8A 12 88 9E 58 18 CA C0 C0
Layer: CYPRESSRFIC DIR INC ADDRESS READDATA
Packet: 7 Time: 9.265167ms Read False CHANNEL_ADR 0

Below is a sample of packets copied in Text format and pasted into Notepad.

```
     Layer: CYPRESSRFIC         DIR     INC      ADDRESS     WRITEDATA
Packet:  1  Time: 7.339333ms   Write   False   CHANNEL_ADR       0

     Layer: CYPRESSRFIC         DIR     INC      ADDRESS     WRITEDATA
Packet:  2  Time: 7.347833ms   Write   False   QX_CTRL_ADR       82

     Layer: CYPRESSRFIC         DIR     INC     ADDRESS     READDATA
Packet:  3  Time: 7.356833ms   Read    False   RSSI_ADR       20

     Layer: CYPRESSRFIC         DIR     INC          ADDRESS          QXOW   SOPDET   QXB16   QXB8   QXB1   QXBERR   QXC   QXE
Packet:  4  Time: 9.189167ms   Read    False   QX_IRQ_STATUS_ADR     0       1        0       1      1       0       1     1

     Layer: CYPRESSRFIC         DIR     INC       ADDRESS                          QXDATA
Packet:  5  Time: 9.198833ms   Read    False   QX_BUFFER_ADR   08 82 1E 99 A7 28 2A 8A 12 88 9E 58 18 CA C0 C0

       Layer: QXDATA                          RECEIVEDATA
Packet:  6  Time: 9.204667ms   08 82 1E 99 A7 28 2A 8A 12 88 9E 58 18 CA C0 C0

     Layer: CYPRESSRFIC         DIR     INC      ADDRESS     READDATA
Packet:  7  Time: 9.265167ms   Read    False   CHANNEL_ADR       0
```

SEARCHING FOR PACKETS

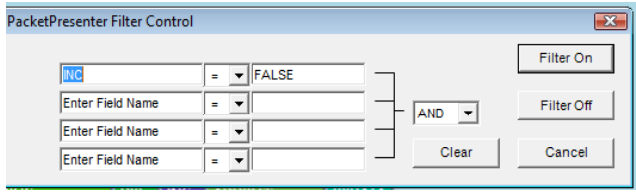
Once displayed, you can search for the next packet that contains certain fields that match your criteria. Below is the Search Packet dialog box that is shown by using the **View | Packet Search** menu item.



In the leftmost textboxes, type the Field Label. Then select the comparator operator (equals, not equals, less than, greater than…) and finally the value that the field is to be compared against. Finally, if there is more than one field in the search list, choose whether to AND or OR the search terms. When you click Find, the next packet in the list (starting from the top of the window) will be placed at the top of the window. You can search forward or backward by selecting the appropriate radio button on the right.

FILTERING PACKETS

Once displayed, you can filter the output to only show packets that contains certain fields that match your criteria. Below is the Filter Packet dialog box that is shown by selecting the **View | Packet Filter** along with the resulting PacketPresenter output.



In the leftmost textboxes, type the Field Label. Then select the comparator operator (equals, not equals, less than, greater than…) and finally the value that the field is to be compared against. Finally, if there is more than one field in the search list, choose whether to AND or OR the search terms. When you click **Filter On**, only the packets matching the criteria are displayed. To turn off the filtering, click on the **Filter Off** button.

PACKETPRESENTER TO WAVEFORM ASSOCIATION USING CURSORS

The PacketPresenter output and waveform display are synchronized using the Cursors. This feature allows you to correlate what is shown in the PacketPresenter window to the actual waveform on the logic analyzer that created that packet.

You can place the cursors using the PacketPresenter window by using the left and right mouse buttons. Place the mouse over the packet you want to place the cursor on and click the left or right mouse button. The cursors are placed at the beginning of the packets. The resulting difference between cursors is shown in the Measurement Window.

Conversely, if you place the X1 and X2 cursor in the Waveform display using the Cursors Bar, the cursors are moved in the PacketPresenter window and it is scrolled to show that location in the packet list.

PACKETPRESENTER DEFINITION FILE FORMAT

Each PacketPresenter Definition file defines how the incoming data stream is represented in the PacketPresenter screen of the USBee QX Suite application. These PacketPresenter Definition files are in text format and are easily created using a simple text editor.

Each bus defined in the USBee QX Suite application can have a different PacketPresenter Definition File.

The intent of the PacketPresenter is to produce a series of 2 dimensional arrays of labels and values to be displayed as below by the user interface.

Command	Length	Address	Data
45	2	84DF	34

Command	Value
Read RSSI	14.34

Command	Setting
23	Power Amp On

It is the PacketPresenter Definition File that defines how the data is to be parsed and displayed.

COMMENTS IN THE PACKETPRESENTER DEFINITION FILE

Comments are started with a semicolon (;) and go until the end of the line.

CONSTANTS IN THE PACKETPRESENTER DEFINITION FILE

Constants are fixed numbers anywhere in the file. These constants can be expressed as decimal, hex, or binary using suffixes after the value. Decimal has no suffix. Hex uses the suffix “h”. Binary uses the suffix “b”.

So,

```
16 = 10h = 10000b
244 = F4h = 11110100b
```

Gain and offset values used in the Fields section are always in decimal and can contain decimal places.

PACKETPRESENTER DEFINITION FILE SECTIONS

Each PacketPresenter Definition File has the following syntax that separates the file into sections that correspond to the Channel definition and each of the Protocol Processors.

```
[Protocol]
. . .
[Protocol]
. . .
[Protocol]
. . .
```

PROTOCOL SECTION

Each Protocol Section defines what the incoming data stream looks like, how to break the data stream into packets, and how to parse out the fields in each of the packets. Multiple Protocol Sections can be defined for passing data from one Protocol Section to another.

Each Protocol Section has the following syntax that specifies the packetizing and parsing into fields.

```
[Protocol]
name = ProtocolName
[Packet]
   packet processing settings
[Fields]
   packet field processing settings
   packet field processing settings
   packet field processing settings
   . . .
```

The *ProtocolName* is a label that uniquely identifies this protocol processor. This name is used in the Field definitions to define which Protocol to route a field of data (for use by multilayer protocols).

The highest level Protocol is the first protocol in the file. This is the Protocol Processor that is sent the incoming data stream from the bus as defined in the Channel Settings Dialog Box for that waveform.

BYTE-WISE BUSSES VS. BIT-WISE BUSSES

Some busses are by nature byte oriented, while others are bit oriented. The following table shows the type of bus.

Bytewise Busses

- Async
- I2C
- Parallel
- SPI
- PS2

Bitwise Busses

- Serial
- I2S
- OneWire
- CAN
- USB
- SDIO

BUS EVENTS

Each bus type also can have certain bus events that may be significant in the decoding of a protocol. One such event is an I2C Start Bit. While the Start bit is not an actual bit in the data stream, it does signify to the I2C slave that a certain transaction is taking place. These bus events are inserted into the data stream and can be used (or ignored) by the protocol processors. The list of Bus Events supported is in the following table.

Bus Type	Event
Async	1 – Parity Error
I2C	1 - Start Bit 2 - Stop Bit 4 - ACK 8 – NACK
SPI	1 - SS Active 2 - SS Inactive Note: You MUST have SS On in the channels settings for these events to occur
USB	1 – SETUP/IN/OUT Received 2 –ACK/NACK/Stall Received 4 – No Handshake received
CAN	1 – Start of CAN packet 2 – End Of CAN packet
1-Wire	1 - Reset Found 2 - Presence Found
Parallel	
Serial	
PS/2	1 – Device to Host byte follows 2 – Host to device byte follows
I2S	1 - WordSelect Active 2 - WordSelect InActive
SMBus	1 - Start Bit 2 - Stop Bit

SDIO	1 - Start of Packet 2 - End of Packet 3 - APP CMD packet 4 - R1 response packet 5 - R2 response packet 6 - R3 response packet 7 - R6 response packet 8 - Data Packet 9 – R4 response packet 0 – R5 response packet

A Bus Event of 127 (7Fh) is a special event that occurs at the end of a packet of data that is sent from one protocol to another. This can be used to end the packet sent to the new layer using the [END] section and the type = event in the new protocol level.

DATA CHANNELS AND MULTIPLE DATA SIGNALS

Some buses can also have more than one data signal used in the protocol. One example of this is the SPI bus, where for each byte sent on the MOSI line there is one byte received on the MISO line. In the protocol definition you can specify which of the signals to expect the next field of data to be sent on. In the SPI example, you may get a Command and Length field on one signal, followed by the read data back on the other signal. The decoder would take that into account and show the command, Length and Data as a single transaction.

Multiple signals are differentiated in the PacketPresenter using the X and Y channel specifiers. These channels are specified by selecting the signals to use for that bus in the Channel Settings dialog box. The following table shows which signals are the X and Y signals.

Bus Type	Channel Setting Dialog Box setup for Channel X	Channel Setting Dialog Box setup for Channel Y	Notes
ASYNC	Least Significant Async Channel selected	Next Least Significant Async Channel selected	If more than 2 Async channels are selected to be decoded, the additional channels are not used by the PacketPresenter.
SPI	Signal chosen for MISO	Signal chosen for MOSI	Data Bytes alternate channels since there is one byte X for every one byte Y
1 Wire	Data Signal	Not used	
I2C	Data on SDA/SCL bus	Not Used	
Parallel	All Data Signals sampled together	Not Used	Each sample of all channels is the data word sent to channel X
Serial	Serial Data	Not Used	
CAN	QX Data	Not Used	
PS/2	Data from Device to Host	Data from Host To Device	
USB	Data on D+/D- bus	Not Used	The data stream contains the Sync, PIDs, data fields and CRCs.
SDIO	CMD traffic	DAT data traffic	

Table 1. Channel X and Channel Y Definitions Per Bus Type

PACKET SECTION

The Packet section defines how a packet is bounded and what, if any, preprocessing needs to be done on the packet before the fields can be processed.

```
[Packet]
[Start]
                . . .  ; How does a packet start?
[End]
                . . .  ; How does a packet end?
[Decode]
                . . .  ; What decoding needs to be
                       ; done to get real data?
```

START AND END SECTIONS

The Start and End sections define how a packet is bounded. The available packet bounding Types are defined below:

For [START]

- Next: The next byte or bit is assumed the start of a packet
- Signal: An external signal indicates the start of a packet
- Value: A specific value in the data indicates the start of a packet
- Event: A bus specific bus Event or Events indicates the start of a packet

For [END]

- Next: The next byte or bit is assumed the end of a packet
- Signal: An external signal indicates the end of a packet
- Value: A specific value in the data indicates the end of a packet
- Length: A specific or calculated length determines the end of a packet
- Event: A bus specific bus Event or Events indicates the end of a packet
- Timeout: A packet ends after a set timeout without data or events

TYPE = NEXT

The start or end of a packet is the next byte or bit to arrive.

```
[Packet]
[Start] or [End]
type = Next      ; Start/End of a packet is the
                  ; next byte/bit to arrive
```

You can use the EXCLUDE keyword in the [END] section to leave the end data on the data stream for the next packet. This is useful for when there is no indication of the end of a packet except for the arrival of the next packet.

TYPE = SIGNAL

The start or end of a packet can be indicated by a separate signal (such as a chip select or a frame signal) using the signal setting.

```
[Packet]
[Start] or [End]
type = signal                    ; Start/End of a packet is based
                                 ; on a signal
signal = signalvalue             ; Signal number 0 - 15
level = 1                        ; level the signal needs to be
```

TYPE = VALUE

The start or end of a packet can be indicated by a certain data value contained in the data using the value setting. Multiple values can be used, where any one match starts or ends a packet. All bits in the Value are included in the resulting packet at the start of the packet. You must also specify the number of bits that the value covers (defaults to 8 bits if not specified) using the bits keyword. You can specify a mask value to apply to the start data and values. When the mask value has a bit that is a 1, that bit in the value and data are compared. All values are assumed MSB first.

```
[Packet]
[Start] or [End]
type = value     ; Start/End of a packet is based on a data value
mask = bitmask   ; Bitmask to apply to the data stream
value = value1   ; value that the data needs to be to start/End
value = value2   ; value that the data needs to be to start/End
value = value3   ; value that the data needs to be to start/End
bits = 8         ; how many bits in the start/End word
```

You can use the EXCLUDE keyword in the [END] section to leave the end data on the data stream for the next packet. This is useful for when there is no indication of the end of a packet except for the arrival of the next packet.

TYPE = LENGTH

Only valid in the [END] section, the end of a packet can be indicated by a certain length of data. You use the BitLength or the ByteLength keywords to specify how long the packet is. The length can either be a fixed length expressed as a constant, or variable length based on the contents of a packet in the data stream.

```
type = length        ; End of a packet is based
                     ;    on a length
Bytelength = length  ; How many bytes per
                     ;    packet
or
Bitlength = length   ; How many bits per packet
```

To use the contents of one of the fields as the packet length, you use the name of the field defined in the Fields section. You can also do simple arithmetic on the field value to compute the final packet size.

```
type = length      ; End of a packet is based
                   ; on a length
Bytelength = fieldname * 2 + 2
            ; field holding packet size
            ; * (or /) a constant (optional)
            ; + (or -) a constant (optional)
```

If present, the * or / must come before the + or – offset and is executed first.

For example, if *fieldname* Field has the contents of 16, then the following is true:

fieldname * 2 + 2 = (16*2)+2 = 34

fieldname + 2 = 16+2 = 18

fieldname / 2 - 2 = (16/2)-2 = 6

fieldname / 2 = 16/2= 8

fieldname + 2 * 2 = invalid (* must come before offset)

fieldname - 2 / 2 = invalid (/ must come before offset)

The length of the packet includes ALL of the data from each of the data channels for that bus. If the bus contains only one data channel (such as I2C), the length counts all data on that one bus. If the bus has two data channels, the length refers to all data on both channels combined.

TYPE = EVENT

The start or end of a packet can be indicated by the reception of any of the bus specific Events. For example in I2C you get a Bus Event for each Start Bit and a Bus Event for each Stop Bit. In USB you get a Bus Event for each Sync word and a Bus Event for each EOP.

The event value is a bitmask that includes all events that you want to use. If any of the events occur, a packet will be started or ended.

```
type = Event     ; Start/End of a packet is
                 ;    signaled by event
event = 1        ; Use Event 1. Available events
                 ;    depend on bus type
or
event = 3        ; Use either Event 1 or Event 2
```

TYPE = TIMEOUT

The end of a packet is determined by a timeout since the last valid data or event on the bus. The timeout is defined in units of microseconds.

```
[Packet]
[Start]
type = timeout   ; End is after timeout
timeout = 45     ; microseconds since last data/event received
```

CHANNELX, CHANNELY OR CHANNELXORY

CHANNELX, CHANNELY or CHANNELXorY specifies what channel is used when an event or data is defined for starting or ending a packet. Channel X and Channel Y are different based on what the physical bus is and can be found in Table 1. Channel X and Channel Y Definitions Per Bus Type. If it does not matter which channel the data or event occurs on (it could be either), use the CHANNELXorY keyword.

```
[Packet]
[Start]
type = value     ; Start of a packet is based on
                 ;     a data value
value = 41h      ; value of data that starts the
                 ;     packet
bits = 8
channelX         ; data/event must be received
                 ;     on channel X
  or
channelY         ; data/event must be received
                 ;     on channel Y
  or
channelXorY      ; data/event must be received
                 ;     on either channel X or Y
```

DECODE SECTION

Each packet can have encoding on the data that needs to be removed in order to see the real data. This section defines what decoding should be done to the packet. The entire packet from start to end is sent through the decoders. If only select parts of the packet needs to be decoded, you must create your own Add-In decoder using the ADDIN keyword.

Available decoding types are:

Keyword	Definition
NRZI	A bit change on the input means a 1 bit on the output, no change a 0
MANCHESTER	Remove Manchester encoding from data
INVERT	Invert all bits
ZBI5	Zero-Bit Insertion removal (removes the 0 added after 5 1s)
ZBI6	Zero-Bit Insertion removal (removes the 0 added after 6 1s)
ADDIN	Call your own packet decoder using the PacketPresenter API routine APIDecode()
substring	Substitute bytes in the stream (no spaces allowed)

Multiple decoders can be used and are processed in the order listed.

SUBSTITUTIONS

Substitutions allow a sequence of bytes (up to 3) to be replaced with a different set (same size or less) of bytes. They can only be used on bytestreams, not bitstreams. Substrings define the bytes input and the bytes output. The Substrings must not contain any spaces. Examples of this are below:

```
[1]=[2]          ; Replaces all 1s with 2s
[1][2]=[3]       ; Replaces all 1 immediately
                 ;     followed by 2 with 3
[1][2]=[3][4]    ; Replaces all 1 immediately
                 ;    followed by 2 with 3
                 ;    immediately followed by 4
[1][2][3]=[4]    ; Replaces all 1, 2, 3 with 4
[1]=[2][3][4]    ;    INVALID, the number of
                 ;    output bytes must be less
                 ;    than or equal to the input
```

As an example, the HDLC protocol uses the byte value 7Eh as the start and end flag of the packets and replaces all 7Eh in the data with the bytes 7Dh followed by 5Eh. It also replaces all 7Dh in the data with the bytes 7Dh followed by 5Dh. To remove this coding you would use the lines:

```
[7Dh][5Eh]=[7Eh]
[7Dh][5Dh]=[7Dh]
```

FIELDS SECTION

Once the packet is delineated and decoded by the previous sections, it is ready to be displayed by the PacketPresenter. Since each packet is made up of fields, the Fields section defines how the packet is broken up into its fields and what to do with the field data.

FIELD LINES PROCESSING

During processing, the **Fields Section** is processed one **Field Line** at a time in the order that they are listed in the FIELDS section. Each Field Line is parsed against the incoming data packets.

Once a single Field Line is successfully processed and output, the PacketPresenter starts over at the top of the Filed Lines list for the next packet. This ensures that there is only one output packet for each input packet for a given protocol.

There are 2 types of Field Lines. A Field Line can be conditional or unconditional. Unconditional Field Lines are processed for any packet. Conditional Field Lines are only processed if certain fields match a specific value.

Any Unconditional Field Line (no conditionals) generates an output line on the PacketPresenter screen. Any Conditional Field Line that evaluates to True generates an output line on the PacketPresenter screen. Any Conditional Field Line that evaluates to False is skipped and produces no output line on the PacketPresenter screen.

The Field Lines should be listed with the conditional field lines first followed by an unconditional field line to catch all packets that are not explicitly defined in the conditional field lines.

UNCONDITIONAL FIELD LINES

Unconditional Field lines are parsed and decoded data is output for every packet that is input. The Fields specify how to interpret the data and how to output the data.

CONDITIONAL FIELD LINES

Conditional Field Lines provide a means for defining packets whose contents vary based upon the presence of a value in another field. An example of this is a packet that contains a Command Byte that determines the format of the rest of the packet. A Conditional Field Line contains at least one field in the packet that includes the =*Value* token in the input modifiers section.

If the data contained in the conditional fields of a packet matches the =*Value* specified for the field, the packet is parsed and the data is output. If the condition field =*Value* does not match the incoming data, then the processor moves on to the next Field Line until it reaches the end of the Fields section.

FIELD LINE FORMAT

Each Field Line in the Fields Section has the keyword FIELDS followed by a series of individual Fields. Individual fields in a packet are separated by commas. A Field line in the Fields Section defines an entire packet from start to end and has the form:

```
Fields  Field1,Field2,. . . ,FieldN
```

You can also insert a string to be printed out at that location in the packet by using the string ($) operator before the string to be printed. Below is an example of a field line with one string added between the fields.

```
Fields Field1,$String,. . . ,FieldN
```

Each field will be output with a Label and a Value. For String fields, the Label is blank and the Value is the String.

FIELD FORMAT

Each field in the Field Line is defined using the following syntax and contains no spaces:

```
FieldName.InputModifiers (= value).OutputModifiers
```

FieldName is the name of the field. No spaces, commas, semicolons, brackets, dollar signs, periods, or quotes are allowed in the fieldname.

Input and output modifiers change the way incoming data and output data are formatted.

InputModifiers are a string of characters that represent how many bits are in the field and how the input data is to be handled. First is the number of bits in the field, or N if the field is a variable length.

Next is any of the following:

- M: native bit order from that which came off of the bus (default)
- L: inverted bit order from that which came off of the bus
- B: invert the Byte order of this multibyte field
- X or Y: which channel the data is on (for multiline busses)
- =*Value*: Indicates that this field MUST be this value for the entire line to be processed (**Conditional**)

Each modifier is a single character and multiple format modifiers can be combined.

There can only be one Variable length field (using the N input modifier) for each channel (x or y) for any given packet.

Example input modifiers are as follows:

```
8          ; 8 bits
8L         ; 8 bits lsb first
8X         ; 8 bits from channel X
8Y         ‘ 8 bits from the Y channel
8=47h      ; 8 bits that must equal 47 hex.  If they do not, then this line is ignored
N          ; all bits of the packet (on channel X) not used by other fields
NY         ; all bits on channel Y not used by other fields
```

OutputModifiers are a string of characters that represent how to output the contents of this data.

Output Modifiers are as follows:

- I Ignore - no output (entire field is ignored for output)
- D Decimal output
- H Hexadecimal output
- B Binary output
- A Ascii output
- TF True (nonzero) or False (zero)
- TFT True (nonzero) or False (zero), but only show if True
- TFF True (nonzero) or False (zero), but only show if False
- L Look up the text string to print out in a matching Lookup line
- **Value* or /*Value*: a value to multiply/Divide the output value by
- +*Value* or -*Value*: a value to offset the output value by
- $string: string to print after the data (or in place of the data if the i flag is used). String must be the last item in a field. No commas, quotes, semicolons or parenthesis allowed in the string.

BUS EVENTS IN THE MIDDLE OF A PACKET

Sometimes a specific bus event plays a role in the packet format. To specify that a specific bus event needs to occur at a specific time in the field sequence, place the single Bus Event value inside brackets in the Field Line. Multiple events in a single value are not allowed, however consecutive events are allowed. To indicate the absence of a specific bus event in the protocol, use the ! (Not) operator.

For example, if the bus is I2C, use the following to require that a Start Bit is present between field1 and field2:

```
Fields  Field1,[1],Field2
```

If there is a start bit between the 2 fields, then that Field Line will be processed.

And use the following to require that a Start Bit is NOT present between field1 and field2:

```
Fields  Field1,[!1],Field2
```

If there is a start bit between the 2 fields, then that Field Line will not be processed.

The Bus Events are defined in **Error! Reference source not found.**.

LOOKUP TABLES

Often fields contain values that mean something unrelated to the actual number of the data. Lookup Tables provide a way to output a string of text instead of a data value for a field. For each field wanting to use a lookup table, use the "L" output modifier in the field format and then define the table in the FIELDS section using the LOOKUP keyword.

The format of the Lookup table is as follows:

```
LOOKUP Fieldname
[value1]=$string1
[value2]=$string2
. . .
```

Fieldname is the name of the field associated with this lookup table. *valuen* refers to the actual data value of the field. *stringn* is the text string that is output instead of the *valuen*.

If a lookup entry is not present for the data value (not found in the Lookup Table or the Lookup Table does not exist), then the data value is output.

For example, the following table will assign the text strings for various values of the data for the CommandByte field. When the field CommandByte,8,L is processed, the strings are output instead of the value

```
Lookup CommandByte
                [0]=$Read
                [1]=$Write
                [2]=$Seek
                [3]=$Loc
                [4]=$Size
```

The Lookup Tables are only associated to the specific Protocol they are contained in. Therefore you can have a CommandByte lookup table in ProtocolA that is different from a CommandByte lookup table in ProtocolB. Within a single Protocol, you need to make sure that the Fieldnames are unique for all Lookup Tables so that the PacketPresenter can determine which table to use.

JUST PLAIN DATA

Fields contain data that may or may not be of interest to the user. Many times the data is information that just needs to be output to the viewer. Being binary data, each field may need to be translated numerically to mean something. To output a field of data, you can specify the radix (if it should be shown in Hex, Decimal, binary) as well as a gain and offset to scale the data. Finally you can add a string to the field to complete the information. All scaling is performed first using floating point and then the output formatting is applied.

Below is an example of a field to just output the data.

```
Fields Volts.16m.d*1.5-37.256$mV
```

This Field Line contains one field named "Volts", which is 16 bits long in msbit first order. The output is to be displayed in decimal format, multiplied by 1.5, offset by - 37.256 and finally appended with "mV" before output to the PacketPresenter screen.

For an input packet as follows:

```
0000001100001100. . .
```

The output would be:

Volts
1132.744mV

which is the input 16 bits in msbfirst order (0x30C) times the gain of 1.5 plus the offset of -37.256 output in decimal format plus the "mV" string.

CONDITIONAL PACKET FORMAT

Using the Conditional input modifier, many different field arrangements can be defined for the same packet. Common uses are for parameter fields that exist for different types of commands. If packets contain commands that determine what the remaining fields are, this syntax defines what those remaining fields are.

Below is an example of various packet formats based on a single command field.

```
Fields Command.4m=0.h,Address.8m.h
Fields Command.4m=2.h,Address.8m.h,Data.8m.h
Fields Command.4m=4.h,Param1.8m.h,Param2.8m.h,Param3.8m.h
```

For an input packet as follows:

```
0010 00011101 00001000. . .
```

Followed by a packet:

```
0100 00011101 00001000 11111110. . .
```

The output would be:

Command	Address	Data
2	1D	08

Command	Param1	Param2	Param3
4	1D	08	FE

which are the fields associated with the Command=2 and Command=4 Field Lines.

STRING LOOKUP

Fields that can be better expressed as text strings can be outputted as such using a Lookup table.

Below is an example of a field that uses a lookup table.

```
[Fields]
Fields StartByte.8.H, CommandByte.8.L, EndByte.8.H
Lookup CommandByte
                                    [0]=$Read
                                    [1]=$Write
                                    [2]=$Seek
                                    [3]=$Loc
                                    [4]=$Size
```

For an input packet as follows:

```
00100001 00000001 00001000. . .
```

The output would be:

StartByte	Command	EndByte
21	Write	08

which is the text associated with the Command Field 4 bits in msbfirst order (0010b = 2).

CONDITIONAL ROUTE OF DATA TO ANOTHER PROTOCOL

Many embedded protocols support multiple layers of protocol, where each protocol layer handles a different set of services or functions. In these multilayer protocols, a field of data from one protocol layer may be the input data to another layer of protocol. Routing this field of data to a new Protocol is as easy as naming the Field the same name as the Protocol. If the Field name matches any protocol, the entire data for that field is passed to that Protocol for processing.

Below is an example that shows a field being sent to a new layer (Layer2) of protocol when the command field is a 1.

```
[Protocol]
name = Layer1
[Packet]
[Decode]
[Fields]
Fields Command.4=0.h,Address.8.h
Fields Command.4=1.h,Layer2.48.h

[Protocol]
name = Layer2
[Packet]
[Decode]
[Fields]
Fields L2Command.4=0.h,RSSI.8.d
Fields L2Command.4=1.h,QoS.16.d
Fields L2Command.4=2.h,Layer3.44.h
```

PACKETPRESENTER ADD-IN API

The USBee QX PacketPresenter automatically processes many types of data streams. However, it cannot decode custom coded data streams. Using the PacketPresenter Add-In API, the data stream can be decoded to the basic data values for any custom coding.

The USBee QX software package includes a sample DLL project in Microsoft VC6 format (in the installation directory of the USBee QX software) called AddIn that allows you to customize a decoder for your data streams.

The DLL library called usbeeai.dll (USBee Add-In) has the following interface routine that is called by the PacketPresenter if the ADDIN keyword is used in the DECODE section of the PacketPresenter Definition File.

```
CWAV_EXPORT unsigned int CWAV_API  APIDecode(
                                   char *Protocol,
                                   char bitIn,
                                   char &bitOut,
                                   char reset );
```

This routine is called for each bit of data in the data stream. Protocol is the string name of the Protocol being processed and allows you to create an add-in that handles many different kinds of decoding. The parameter “reset” is set to a 1 for the first bit of a packet and 0 for all bits following. The next bit from the stream is passed in using the parameter “bitIn” (1 or 0).

After your code decodes the stream, you can either send back no data (return value of 0), or send new bits back using the “bitOut” pointer (one bit per char) and a return value of the number of bits returned.

The default Add-In routine simply is a pass through so that the output data stream equals the input data stream. Start with this library source code to add your custom decoding.

SAMPLE PACKETPRESENTER ADD-IN DECODERS

Custom decoders can perform complicated decryption and byte or bit manipulation. Ignoring the actual algorithm that is executed, these decoders may reduce, enlarge or keep constant the number of bits in the data stream. The following examples are intended to show how these streams can be shortened, lengthened or modified. Useful decoders will need to have the appropriate algorithms to compute the true values of the output bits.

LOOPBACK DECODER

This Add-In simply loops back the data (out = in).

```
CWAV_EXPORT unsigned int CWAV_API APIDecode(char *Protocol, char bitIn, char *bitsOut, char reset )
{

            // This will be the Add-In routine that is called by the PacketPresenter
            // when the ADDIN keyword is used in the DECODE section of the
            // PacketPresenter Definition File.

            // This routine is called for each bit of data in a data packet.
            // The parameter "reset" is set to a 1 for the first bit of a packet and
            // 0 for all bits following.  The next bit from the stream is passed in
            // using the parameter "bitIn" (1 or 0). After your code decodes the stream,
            // you can either send back no data (return value of 0), or send new bits back
            // using the "bitOut" pointer (one bit per char) and a return value of the number
            // of bits returned. The default Add-In routine is simply is a pass through so
            // that the output data stream equals the input data stream.
            // Start with this library source code to add your custom decoding.

            *bitsOut = bitIn;

            return( 1 );                        // Indicates that there is 1 return data bit
}
```

INVERTING DECODER

This Add-In inverts the packet data (out = Not(in)).

```
CWAV_EXPORT unsigned int CWAV_API APIDecode(char *Protocol, char bitIn, char *bitsOut, char
reset )
{
           if (bitIn)
                      *bitsOut = 0;
           else
                      *bitsOut = 1;
           return( 1 );                    // Indicates that there is 1 return data bit
}
```

EXPANDING DECODER

This Add-In shows how to convert a stream to a larger stream (expanding the bits). In this case each bit becomes two output bits.

```
CWAV_EXPORT unsigned int CWAV_API  APIDecode(char *Protocol, char bitIn, char *bitsOut,
char reset )
{
           *bitsOut++ = bitIn;
           *bitsOut++ = bitIn;

           return( 2 );                    // Indicates that there is 2 return data bits
}
```

COMPRESSING DECODER

This Add-In shows how to remove bits from a stream (compressing the bits). In this case each bit pair becomes a single bit, basically throwing away the first bit.

```
CWAV_EXPORT unsigned int CWAV_API  APIDecode(char *Protocol, char bitIn, char *bitsOut,
char reset )
{
          static everyother = 0;

          if (reset)                              // Reset the state of the decoder if
reset=TRUE
                    everyother = 0;

          if (everyother)
          {
                    *bitsOut = bitIn;
                    return( 1 );                  // Indicates that there is 1 return data
bit
                    everyother = 0;
          }
          else
                    everyother = 1;

          return( 0 );                  // Indicates that there are no return data bits
}
```

MULTIPLE DECODERS

This Add-In shows how to use the Protocol string to selectively decode different types of packets.

```
CWAV_EXPORT unsigned int CWAV_API  APIDecode(char *Protocol, char bitIn, char *bitsOut,
char reset )
{
     static everyother = 0;

     if (!strcmp( Protocol, "COMPRESS")
     {
          if (reset)               // Reset the state of the decoder if reset=TRUE
               everyother = 0;
          if (everyother)
          {
               *bitsOut = bitIn;
               return( 1 );        // Indicates that there is 1 return data bit
               everyother = 0;
          }
          else
               everyother = 1;
          return( 0 );        // Indicates that there are no return data bits
     }
     else if (!strcmp( Protocol, "EXPAND")
     {
          *bitsOut++ = bitIn;
          *bitsOut++ = bitIn;
          return( 2 );        // Indicates that there is 2 return data bits
     }

     // No matching decoder label found so just loopback the data
     *bitsOut = bitIn;

     return(1);
}
```

PACKETPRESENTER DEFINITION FILE DEBUGGING

Creating your PacketPresenter Definition File can be made simpler using the Debug mode. To turn on Debug mode, use the DebugOn keyword in ***ALL*** [DEBUG] sections of the Definition File.

```
[Protocol]
                    name = I2CEEPROM
[DEBUG]
                    DebugOn          ; Turns On Debug Mode.
                                     ; Comment it out to turn it off.
[Packet]
```

When debug mode is on, each packet is output twice in its raw form, showing the data values as well as the events from the bus. The first debug line is the initial bus data. The second line is the bus data after any decoding is completed. Following the debug lines are the PacketPresenter output packets from this same data.

Below is a screen shot that shows the PacketPresenter that has Debug turned on.

PACKETPRESENTER SPECIFICATIONS

The PacketPresenter system has the following limits regarding file size, packets, fields, lookup tables etc.

- 100K bytes per PacketPresenter Definition File
- 64K Data Records per Packet (min 64K bits, max 64K bytes)
- 7 Protocols
- 1024 Field Lines per Protocol
- 128 Fields per Field Line
- 64 Lookup Tables per Protocol
- 256 Lookup entries per Lookup Table
- 256 Decoder Substitutions per Protocol
- 3 Bytes per Substitution input or output
- 4 PacketPresenter Windows
- 2.1B bytes per PacketPresenter Output File

ASYNC PROTOCOL EXAMPLE

```
; Async Protocol Definition File
; This file defines the transfers to/from a custom device
; over an ASYNC bus
;
[Protocol]
    name = ASYNCBus
    bytewise
[DEBUG]
    ;DebugOn       ; Uncomment this to turn on Debug Packets
[Packet]
    [Start]
        type = value
        value = 40h; Start command
        mask = F0h  ; Mask out the channel number

    [End]
        type = timeout
        timeout = 3000 ; 3ms timeout ends the packet

    [Decode]
    [Fields]


        Fields
            Start.4.h,
            Channel.4=1.h,
            Command.8.h,
            X.16.d/20.48-25$g,
            Y.16.d/20.48-25$g,
            Z.16.d/20.48-25$g,
            Rest.N.h    ; Rest of the packet

        Fields
            Rest.N.h    ; Rest of the packet
```

I2C PROTOCOL EXAMPLE

```
; I2C EEPROM Protocol Definition File
; This file defines the transfers to/from an I2C EEPROM
; with 8 bit address
;
[Protocol]
     name = I2CEEPROM
     bytewise
[DEBUG]
     ;DebugOn       ; Uncomment this to turn on Debug Packets
[Packet]
     [Start]
          type = event
          event = 1 ; Start Bit

     [End]
          type = event
          event = 0Ah    ; Stop Bit Or NACK

     [Decode]
     [Fields]

          ; Device Not Present
          Fields
               $Device Not Present,              ; Printout this label if match
               SlaveAddress.7m.h,RW.1.i,         ; Control Byte
               Address.8m.h,                     ; 1 byte address
               [8]                               ; followed by a NACK condition

          ; Set Address
          Fields
               $SetAddressCmd,                   ; Printout this label if match
               SlaveAddress.7m.h,RW.1=0.i,       ; Control Byte
               Address.8m.h,                     ; 1 byte address
               [2]                               ; followed by a STOP condition

          ; Write Command
          Fields
               $WriteCommand,                    ; Printout this label if match
               SlaveAddress.7m.h,RW.1=0.i,       ; Control Byte
               Address.8m.h,                     ; 1 byte address
               [!1],                             ; NO START condition
               WriteData.Nm.h                    ; Written Data (Variable N)

          ; Current Address Read
          Fields
               $CurrentRead,                     ; Printout this label if match
               SlaveAddress.7m.h,RW.1=1.i,       ; Control Byte
               ReadData.Nm.h                     ; Read Data (Variable number N)

          ; Random Read
          Fields
               $RandomRead,                      ; Printout this label if match
               SlaveAddress.7m.h,RW.1=0.i,       ; Control Byte
               Address.8m.h,                     ; 1 byte address
               [1],                              ; START Condition
               SlaveAddress.7m.i,RW.1=1.i,       ; Control Byte
               ReadData.Nm.h,                    ; Read Data (Variable number N)
```

SPI PROTOCOL EXAMPLE

```
; Cypress RF IC Protocol Definition File
; This file defines the transfers to/from a CY6936 RF IC
; using the SPI bus
[Protocol]
     name = CypressRFIC
     bytewise
[DEBUG]
     ;DebugOn
[Packet]
     [Start]
          type = event
          event = 1 ; SS goes active

     [End]
          type = event
          event = 2 ; SS goes inactive
     [Decode]
     [Fields]
          ; QX_IRQ_STATUS_ADR Read and Write Command
          Fields    Dir.1y=0.L, Inc.1y.tf, Address.6y=07h.L, Dummy.8x.i, QXOW.1x.h,
                    SOPDET.1x.h, QXB16.1x.h, QXB8.1x.h, QXB1.1x.h, QXBERR.1x.h, QXC.1x.h,
                    QXE.1x.h
          Fields    Dir.1y=1.L, Inc.1y.tf, Address.6y=07h.L, QXOW.1y.h, SOPDET.1y.h,
                    QXB16.1y.h, QXB8.1y.h, QXB1.1y.h, QXBERR.1y.h, QXC.1y.h, QXE.1y.h

          ; TX_IRQ_STATUS_ADR Read and Write Command
          Fields    Dir.1y=0.L, Inc.1y.tf, Address.6y=04h.L, Dummy.8x.i, OS.1x.h, LV.1x.h,
                    TXB15.1x.h, TXB8.1x.h, TXB1.1x.h, TXBERR.1x.h, TXC.1x.h, TXE.1x.h
          Fields    Dir.1y=1.L, Inc.1y.tf, Address.6y=04h.L, OS.1y.h, LV.1y.h, TXB15.1y.h,
                    TXB8.1y.h, TXB1.1y.h, TXBERR.1y.h, TXC.1y.h, TXE.1y.h

          ; QX_BUFFER_ADR Read and Write Command
          Fields    Dir.1y=0.L,    Inc.1y.tf,     Address.6y=21h.L,  Dummy.8x.i,
                    QXData.Nx.h
          Fields    Dir.1y=1.L,    Inc.1y.tf,     Address.6y=21h.L,  QXData.Ny.h


          ; TX_BUFFER_ADR Read and Write Command
          Fields    Dir.1y=0.L,    Inc.1y.tf,     Address.6y=20h.L,  Dummy.8x.i,
                    TxData.Nx.h
          Fields    Dir.1y=1.L,    Inc.1y.tf,     Address.6y=20h.L,  TxData.Ny.h

          Fields    Dir.1y=0.L,    Inc.1y.tf,     Address.6y.L,      Dummy.8x.i,
                    ReadData.Nx.h
          Fields    Dir.1y=1.L,    Inc.1y.tf,     Address.6y.L,      WriteData.Nmy.h

          Lookup Dir
              [0]=$Read
              [1]=$Write

          Lookup Address
              [00h]=$CHANNEL_ADR
              [01h]=$TX_LENGTH_ADR
              [02h]=$TX_CTRL_ADR
              [03h]=$TX_CFG_ADR
              [04h]=$TX_IRQ_STATUS_ADR
              [05h]=$QX_CTRL_ADR
              [06h]=$QX_CFG_ADR
              [07h]=$QX_IRQ_STATUS_ADR
              [08h]=$QX_STATUS_ADR
              [09h]=$QX_COUNT_ADR
              [0ah]=$QX_LENGTH_ADR
              [0bh]=$PWR_CTRL_ADR
              [0ch]=$XTAL_CTRL_ADR
              [0dh]=$IO_CFG_ADR
              [0eh]=$GPIO_CTRL_ADR
              [0fh]=$XACT_CFG_ADR
              [10h]=$FRAMING_CFG_ADR
              [11h]=$DATA32_THOLD_ADR
              [12h]=$DATA64_THOLD_ADR
              [13h]=$RSSI_ADR
              [14h]=$EOP_CTRL_ADR
              [15h]=$CRC_SEED_LSB_ADR
              [16h]=$CRC_SEED_MSB_ADR
              [17h]=$TX_CRC_LSB_ADR
              [18h]=$TX_CRC_MSB_ADR
              [19h]=$QX_CRC_LSB_ADR
```

```
              [1ah]=$QX_CRC_MSB_ADR
              [1bh]=$TX_OFFSET_LSB_ADR
              [1ch]=$TX_OFFSET_MSB_ADR
              [1dh]=$MODE_OVERRIDE_ADR
              [1eh]=$QX_OVERRIDE_ADR
              [1fh]=$TX_OVERRIDE_ADR
              [26h]=$XTAL_CFG_ADR
              [27h]=$CLK_OVERRIDE_ADR
              [28h]=$CLK_EN_ADR
              [29h]=$QX_ABORT_ADR
              [32h]=$AUTO_CAL_TIME_ADR
              [35h]=$AUTO_CAL_OFFSET_ADR
              [39h]=$ANALOG_CTRL_ADR
              [20h]=$TX_BUFFER_ADR
              [21h]=$QX_BUFFER_ADR
              [22h]=$SOP_CODE_ADR
              [23h]=$DATA_CODE_ADR
              [24h]=$PREAMBLE_ADR
              [25h]=$MFG_ID_ADR

[Protocol]
     name = QXData
     bytewise
[DEBUG]
     ;DebugOn
[Packet]
     [Start]
          type = next
     [End]
          type = event
          event = 127    ; All Data passed in

     [Decode]
     [Fields]
          ; QX_IRQ_STATUS_ADR Read and Write Command
          Fields    ReceiveData.N.h
```

CAN PROTOCOL EXAMPLE

```
; CAN Protocol Definition File
; This file defines the transfers to/from a custom CAN device
; over a the CAN bus
;
[Protocol]
          name = CANBus
          bitwise
[DEBUG]
          ;DebugOn            ; Uncomment this to turn on Debug Packets
[Packet]
          [Start]
                    type = event
                    event = 1 ; Start of CAN packet
          [End]
                    type = event
                    event = 2 ; End of CAN packet
          [Decode]
          [Fields]

                    ; Extended Frame Format
                    Fields    SOF.1.i, IDA.11.h, SRR.1.h, IDE.1=1.h, IDB.18.h, RTR.1.h,
                              Rsrv.2.i, Length.4.h, Data.N.h, CRC.15.h, CRCDel.1.h,
                              ACK.1.h, ACKDel.1.h, EOF.7.h

                    ; Base frame format
                    Fields    SOF.1.i, ID.11.h, RTR.1.h, IDE.1=0.h, Rsrv.1.i, Length.4.h,
                              Data.N.h, CRC.15.h, CRCDel.1.h, ACK.1.h, ACKDel.1.h,
                              EOF.7.h
```

SDIO PROTOCOL EXAMPLE

```
; SDIO Protocol Definition File
; This file defines the transfers to/from a custom device
[Protocol]
name = SDIO_0
bytewise
[Debug]
;DebugOn       ; Uncomment this to turn on Debug Packets
[Packet]
     [Start]
          type = event
          event = 1 ; Start of Packet
          channelxory
     [End]
          type = event
          event = 2 ; End of Packet
          channelxory
[Decode]
[Fields]
          ; Data Packets
          Fields [8], Data.Ny.h

          ; Do all of the Command Packets
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=4.L, DSR.16x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=7.L, RCA.16x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=9.L, RCA.16x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=10.L, RCA.16x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=13.L, RCA.16x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=15.L, RCA.16x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=16.L, BLOCK_LEN.32x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=17.L, Address.32x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=18.L, Address.32x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=24.L, Address.32x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=25.L, Address.32x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=28.L, Address.32x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=29.L, Address.32x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=30.L, Address.32x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=32.L, Address.32x.h
```

```
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=33.L, Address.32x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=55.L, RCA.16x.h
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x=56.L, nua.31x.i, RD/WR#.1.h
          ; All of the App Command packets
          Fields    [3], Start.1x.h, HOST.1x=1.h, ACMD.6x=6.L, nua.30x.i, BUS_WIDTH.2.h
          Fields    [3], Start.1x.h, HOST.1x=1.h, ACMD.6x=13.L
          Fields    [3], Start.1x.h, HOST.1x=1.h, ACMD.6x=23.L, nua.9x.i, BLOCKS.23.h
          Fields    [3], Start.1x.h, HOST.1x=1.h, ACMD.6x=41.L, OCR.32.h
          Fields    [3], Start.1x.h, HOST.1x=1.h, ACMD.6x=42.L, nua.30x.i, SET_CD.1.h
          Fields    [3], Start.1x.h, HOST.1x=1.h, ACMD.6x.L
          Fields    [!3], Start.1x.h, HOST.1x=1.h, CMD.6x.L
          ; The R6 response packet
          Fields    [7], $R6, Start.1x.h, DEVICE.1x=0.h, CMD.6x.L, RCA.16x.h, STATUS.16x.h
          ; The R3 response packet
          Fields    [6], $R3, Start.1x.h, DEVICE.1x=0.h, CMD.6x.L, OCR.32x.h
          ; The R2 response packet
          Fields    [5], $R2, Start.1x.h, DEVICE.1x=0.h, CMD.6x.L, DATA.128x.h
          ; The R1 response packet
          Fields    [4], $R1, Start.1x.h, DEVICE.1x=0.h, CMD.6x.L,
               OUT_OF_RANGE.1x.tft,
               ADDRESS_ERROR.1x.tft,
               BLOCK_LEN_ERROR.1x.tft,
               ERASE_SEQ_ERROR.1x.tft,
               ERASE_PARAM.1x.tft,
               WP_VIOLATION.1x.tft,
               CARD_IS_LOCKED.1x.tft,
               LOCK_UNLOCK_FAILED.1x.tft,
               COM_CRC_ERROR.1x.tft,
               ILLEGAL_COMMAND.1x.tft,
               CARD_ECC_FAILED.1x.tft,
               CC_ERROR.1x.tft,
               ERROR.1x.tft,
               UNDERRUN.1x.tft,
               OVERRUN.1x.tft,
               CID/CSD_OVERWRITE.1x.tft,
               WP_ERASE_SKIP.1x.tft,
               CARD_ECC_DISABLE.1x.tft,
               ERASE_REST.1x.tft,
               CURRENT_STATE.4x.L,
               READY_FOR_DATA.1x.tff,
               nu1.2x.i,
               APP_CMD.1x.tft,
               nu4.1x.i,
               AKE_SEQ_ERROR.1x.tft,
               RSV_2.1x.i,
               RSV_TEST_MODE.2x.i
Lookup CURRENT_STATE
     [0]=$Idle
     [1]=$Ready
     [2]=$Ident
     [3]=$Stby
     [4]=$Tran
     [5]=$Data
     [6]=$Rcv
     [7]=$Prg
     [8]=$Dis
     [9]=$reserved
     [10]=$reserved
     [11]=$reserved
     [12]=$reserved
     [13]=$reserved
     [14]=$reserved
     [15]=$reserved
Lookup CMD
     [0]=$GO_IDLE_STATE
     [1]=$CMD1
     [2]=$ALL_SEND_CID
     [3]=$SEND_RELATIVE_ADDR
     [4]=$SET_DSR
     [5]=$CMD5
```

```
      [6]=$SWITCH_FUNC
      [7]=$SEL/DESEL_CARD
      [8]=$SEND_IF_COND
      [9]=$SEND_CSD
      [10]=$SEND_CID
      [11]=$VOLTAGE_SWITCH
      [12]=$STOP_TRANSMISSION
      [13]=$SEND_STATUS
      [14]=$CMD14
      [15]=$GO_INACTIVE_STATE
      [16]=$SET_BLOCKLEN
      [17]=$READ_SINGLE_BLOCK
      [18]=$READ_MULTIPLE_BLOCK
      [19]=$SEND_TUNING_BLOCK
      [20]=$SPEED_CLASS_CONTROL
      [21]=$CMD21
      [22]=$CMD22
      [23]=$SET_BLOCK_COUNT
      [24]=$WRITE_BLOCK
      [25]=$WRITE_MULTIPLE_BLOCK
      [26]=$CMD26
      [27]=$PROGRAM_CSD
      [28]=$SET_WRITE_PROT
      [29]=$CLR_WRITE_PROT
      [30]=$SEND_WRITE_PROT
      [31]=$CMD31
      [32]=$ERASE_WR_BLK_START
      [33]=$ERASE_WR_BLK_END
      [34]=$CMD34
      [35]=$CMD35
      [36]=$CMD36
      [37]=$CMD37
      [38]=$ERASE
      [39]=$CMD39
      [40]=$CMD40
      [41]=$CMD41
      [42]=$LOCK_UNLOCK
      [43]=$CMD43
      [44]=$CMD44
      [45]=$CMD45
      [46]=$CMD46
      [47]=$CMD47
      [48]=$CMD48
      [49]=$CMD49
      [50]=$CMD50
      [51]=$CMD51
      [52]=$CMD52
      [53]=$CMD53
      [54]=$CMD54
      [55]=$APP_CMD
      [56]=$GEN_CMD
      [57]=$CMD57
      [58]=$CMD58
      [59]=$CMD59
      [60]=$CMD60
      [61]=$CMD61
      [62]=$CMD62
      [63]=$CMD63
Lookup ACMD
      [6]=$SET_BUS_WIDTH
      [13]=$SD_STATUS
      [22]=$SEND_NUM_WR_BLOCKS
      [23]=$SET_WR_BLK_ERASE_COUNT
      [41]=$SD_APP_OP_COND
      [42]=$SET_CLR_CARD_DETECT
      [51]=$SEND_SCR
```

1-WIRE PROTOCOL EXAMPLE

```
; One Wire Protocol Definition File
; This file defines the transfers to/from some 1-Wire devices
; using the 1-Wire bus
;
[Protocol]
            name = OneWireBus
            bytewise
[DEBUG]
            ;DebugOn                ; Uncomment this to turn on Debug Packets
[Packet]
            [Start]
                        type = event
                        event = 2   ; Presence Pulse

            [End]
                        type = event
                        event = 1   ; Reset Pulse

            [Decode]
            [Fields]

                        ; These fields are used by Maxim/Dallas Digital Thermometers
                        Fields      ROMCommand.8=F0h.$Search Rom, Data.N.h
                        Fields      ROMCommand.8=33h.$Read Rom, Family.8.h, SerialNumber.48.h,
                                    CRC.8.h
                        Fields      ROMCommand.8=55h.$Match Rom, Family.8.h, SerialNumber.48.h, CRC.8.h
                        Fields      ROMCommand.8=CCh.$Skip ROM, Function.8=44h.$ConvertTemp
                        Fields      ROMCommand.8=CCh.$Skip ROM, Function.8=BEh.$Read Scratchpad, Temp.16.d,
TH.8.h, TL.8l.h, Rsvd.16.i, Remain.8.h, CpC.8.h, CRC.8.h

                        ; These fields are used by Dallas Serial Number iButtons
                        Fields      ROMCommand.8=33h.$Read Rom, Family.8.h, SerialNumber.48.h, CRC.8.h
                        Fields      ROMCommand.8=0Fh.$Read Rom, Family.8.h, SerialNumber.48.h, CRC.8.h


                        ; These packets are used by 1-Wire EEPROMS
                        Fields      ROMCommand.8=33h.$Read Rom, Family.8.h, SerialNumber.48.h, CRC.8.h
                        Fields      ROMCommand.8.h, MemoryCommand.8=0Fh.$Write Scratchpad,
                                                Address.16.h, Data.N.h
                        Fields      ROMCommand.8.h, MemoryCommand.8=AAh.$Read Scratchpad,
                                                Address.16.h, ES.8.h, Data.N.h
                        Fields      ROMCommand.8.h, MemoryCommand.8=55h.$Copy Scratchpad,
                                                AuthCode.24.h
                        Fields      ROMCommand.8.h, MemoryCommand.8=F0h.$Read Memory,
                                                     Address.16.h, Data.N.h
```

PARALLEL PROTOCOL EXAMPLE

```
; Sample Parallel Protocol Definition File
; This file defines the transfers to/from an unique device
;
[Protocol]
    name = ADevice
    bytewise
[DEBUG]
    ;DebugOn
[Packet]
    [Start]
        type = signal
        signal = 14
        level = 0

    [End]
        type = length
        Bytelength = 21

    [Decode]
    [Fields]
        Fields
            StartByte.8m.d*2+4$mV,
            CommandByte.8l.L,
            FLength.8m.h,
            SlaveAddress.7m.h,RW.1.L,
            Long.32m.h,
            8Bytes.64m.h,
            NextLayer.Nm.h


[Protocol]
    name = NextLayer
    bytewise
[Packet]
    [Start]
        type = next
    [End]
        type = Event   ;End of a packet is signaled by a event
        event = 127; Means the end of the data (only for higher
layers)

    [Decode]
    [Fields]
        Fields
            Rest.N.h       ; Just print out all the bytes
```

SERIAL PROTOCOL EXAMPLE

```
; Serial Protocol Definition File
; This file defines the transfers from a serial device
;
[Protocol]
    name = SerialBus
    bitwise
[DEBUG]
    ;DebugOn       ; Uncomment this to turn on Debug Packets
[Packet]
    [Start]
        type = value   ; Look for a value in the data to start the
packet
        value = 6211h  ; NOTE: This value is assumed MSbit first in
                       ; the data stream!
        bits = 16
        mask = FFFFh
    [End]
        type = length
        bitlength = 64 ; End of command after 64 bits
    [Decode]
    [Fields]

        ; Send out the bits of the packet
        Fields Start.16.h, Nine.9.h, Seven.7.h, Rest.N.b
```

USB PROTOCOL EXAMPLE

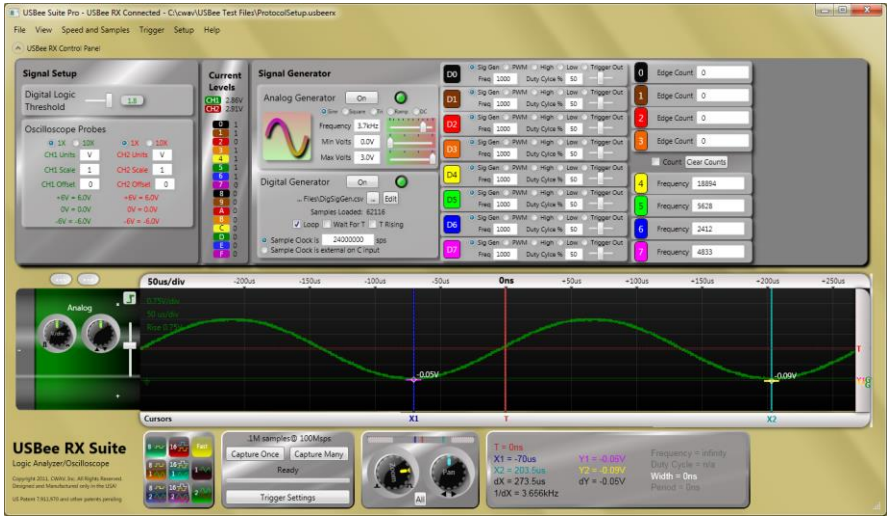
```
; USB Bus Protocol Definition File
; This file defines the transfers to/from a custom USB device
;
[Protocol]
          name = USBBus
          bitwise
[DEBUG]
          ;DebugOn            ; Uncomment this to turn on Debug Packets
[Packet]
          [Start]
                    type = event
                    event = 1 ; Setup/In or Out found
          [End]
                    type = event
                    event = 6 ; ACK, NAK or Stall found or no handshake found
          [Decode]
          [Fields]

                    ; Any Packet - No Response
                    Fields    Sync.8.i, PID.8.L, Addr.7l.d, EP.4l.d, CRC5.5.i, ; Token
                              [4]                                  ; No Handshake

                    ; Setup - Nakd                                 ; Token
                    Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
                              Sync.8.i, HS.8=01011010b.L           ; Handshake

                    ; IN - Nakd
                    Fields    Sync.8.i, PID.8=10010110b.L, Addr.7L.d, EP.4L.d, CRC5.5.i,
                              Sync.8.i, HS.8=01011010b.L          ; Handshake


                    ; OUT - Nakd
                    Fields    Sync.8.i, PID.8=10000111b.L, Addr.7L.d, EP.4L.d, CRC5.5.i,
                              Sync.8.i, HS.8=01011010b.L           ; Handshake

                    ; Setup
                    Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
                              Sync.8.i, PID.8.L, Rtype.8.i,
                              bRequest.8L=1.$Clear Feature, bValue.16L.h, bIndex.16L.H,
                              bLength.16L.H, CRC16.16.i, Sync.8.i, HS.8.L

                    Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
                              Sync.8.i, PID.8.L, Rtype.8.i,
                              bRequest.8L=0.$Get Status, bValue.16L.h, bIndex.16L.H,
                              bLength.16L.H, CRC16.16.i, Sync.8.i, HS.8.L
                    Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
                              Sync.8.i, PID.8.L, Rtype.8.i,
                              bRequest.8L=8.$Get Configuration, bValue.16L.h, bIndex.16L.H,
                              bLength.16L.H, CRC16.16.i, Sync.8.i, HS.8.L
                    Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
                              Sync.8.i, PID.8.L, Rtype.8.i,
                              bRequest.8L=6.$Get Descriptor, bValueL.8L.I, Type.8L.L,
                              bIndex.16L.H, bLength.16L.H, CRC16.16.i, Sync.8.i, HS.8.L
                    Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
                              Sync.8.i, PID.8.L, Rtype.8.i,
                              bRequest.8L=16.$Get Interface, bValue.16L.h, bIndex.16L.H,
                              bLength.16L.H, CRC16.16.i, Sync.8.i, HS.8.L
                    Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
                              Sync.8.i, PID.8.L, Rtype.8.i,
                              bRequest.8L=5.$Set Address, Address.16L.h, bLength.16L.i,
                              bLength.16L.i, CRC16.16.i, Sync.8.i, HS.8.L
                    Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
                              Sync.8.i, PID.8.L, Rtype.8.i,
                              bRequest.8L=9.$Set Configuration, Config.16L.h,
                              bLength.16L.i, bLength.16L.i, CRC16.16.i, Sync.8.i, HS.8.L
                    Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
                              Sync.8.i, PID.8.L, Rtype.8.i,
                              bRequest.8L=7.$Set Descriptor, bValue.16L.h, bIndex.16L.H,
                              bLength.16L.H, CRC16.16.i, Sync.8.i, HS.8.L
                    Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
                              Sync.8.i, PID.8.L, Rtype.8.i,
                              bRequest.8L=3.$Set Feature, bValue.16L.h, bIndex.16L.H,
                              bLength.16L.H, CRC16.16.i, Sync.8.i, HS.8.L
```

```
Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
          Sync.8.i, PID.8.L, Rtype.8.i,
          bRequest.8L=10.$Get Interface, bValue.16L.h, bIndex.16L.H,
          bLength.16L.H,  CRC16.16.i, Sync.8.i, HS.8.L
Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
          Sync.8.i, PID.8.L, Rtype.8.i,
          bRequest.8L=11.$Set Interface, AltSetting.16L.h,
          Interface.16L.H, bLength.16L.H, CRC16.16.i, Sync.8.i, HS.8.L
Fields    Sync.8.i, PID.8=10110100b.L, Addr.7l.d, EP.4l.d, CRC5.5.i,
          Sync.8.i, PID.8.L, Rtype.8.i,
          bRequest.8L=12.$Sync Frame, bValue.16L.h, bIndex.16L.H,
          bLength.16L.H, CRC16.16.i, Sync.8.i, HS.8.L
; IN
Fields    Sync.8.i, PID.8=10010110b.L, Addr.7L.d, EP.4L.d, CRC5.5.i,
          Sync.8.i, PID.8.L, InData.NL.h, CRC16.16.i,   ; Data
          Sync.8.i, HS.8.L                    ; Handshake
; OUT
Fields    Sync.8.i, PID.8=10000111b.L, Addr.7L.d, EP.4L.d, CRC5.5.i,
          Sync.8.i, PID.8.L, OutData.NL.h, CRC16.16.i,   ; Data
          Sync.8.i, HS.8.L                    ; Handshake

; Catch all
Fields Data.NL.h

Lookup    Type
          [1]=$Device
          [2]=$Config
          [3]=$String

Lookup    PID
          [11000011b]=$DATA0
          [11010010b]=$DATA1
          [01001011b]=$ACK
          [01011010b]=$NAK
          [01111000b]=$STALL
          [10110100b]=$SETUP
          [10000111b]=$OUT
          [10010110b]=$IN
          [10100101b]=$SOF

Lookup    HS
          [01001011b]=$ACK
          [01011010b]=$NAK
          [01111000b]=$STALL
```

PS2 PROTOCOL EXAMPLE

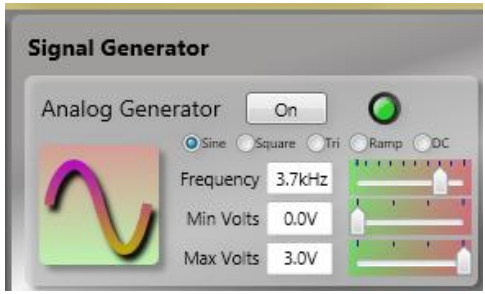
```
; PS2 Protocol Definition File
; This file defines the transfers from a PS2 device
;
[Protocol]
    name = PS2Bus
    bytewise
[DEBUG]
    ;DebugOn       ; Uncomment this to turn on Debug Packets
[Packet]
    [Start]
        type = next    ; Every byte is the start of the next packet
        CHANNELXORY    ; Either Device to Host or Host To Device
    [End]
        type = TIMEOUT
        TIMEOUT = 5000 ; End of command after 5msec
    [Decode]
    [Fields]

        ; Setting LEDs after command
        Fields [1], $Device To Host, $Key Down, Scancode.8x.h, [2],
               $Host To Device, HostCommand.8y=EDh.$Set LEDs,
               Ack.8x.i, Parameter.5y.i, Caps.1y.tf, Num.1y.tf,
               Scroll.1y.tf, Ack.8x.i
        Fields [1], $Device To Host, $Key Down, Scancode.8x.h, [2],
               $Host To Device, HostCommand.8y.h, Ack.8x.i,
               Parameter.8y.h, Ack.8x.i

        ; Device to Host
        Fields [1], $Device To Host, $Key Up, Release.8x=F0h.h,
               Scancode.Nx.h

        ; All other scancodes
        Fields [1], $Device To Host, $Key Down, Scancode.Nx.H

        ; Host to Device
        Fields [2], $Host To Device, Command.Ny.h
```

USBEE QX ANALOG SIGNAL GENERATOR



The USBee QX has an Analog Signal Generator built in. It outputs a voltage pattern on the **Aout** signal out the side of the Pod.

To specify what waveform pattern is generated, you use the Analog Generator section of the USBee QX Control Panel as seen below.

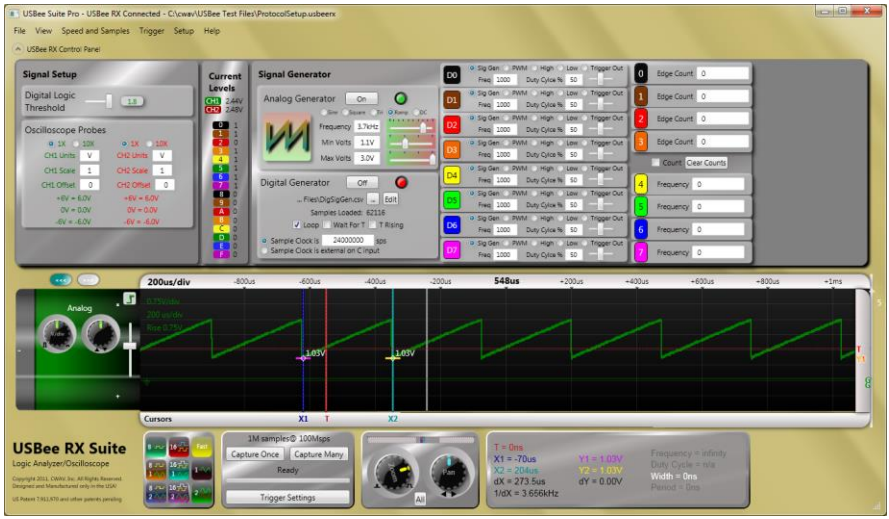


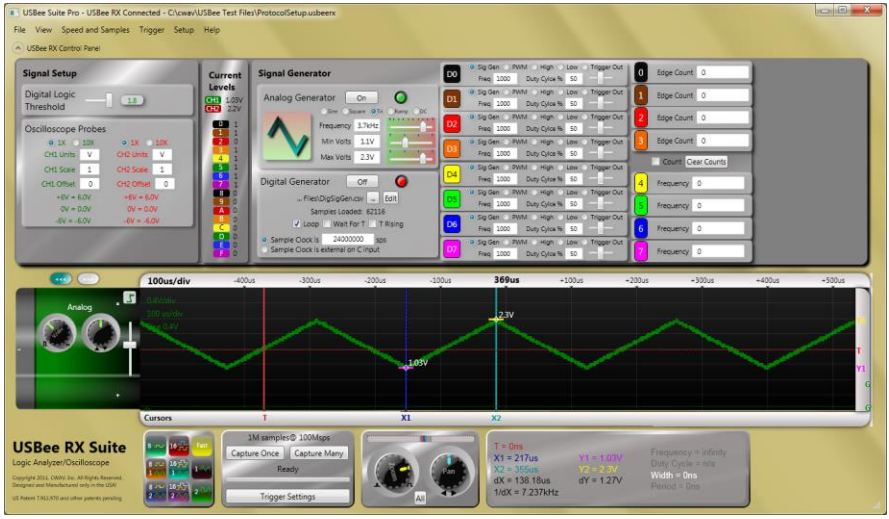
There are 5 types of analog signals that can be generated by selecting the associated radio button:

- Sine
- Triangle
- Ramp
- Square and
- DC

You can also select the frequency generated by using the slider to the right of the Frequency line. The minimum and maximum voltages are also specified using the sliders from 0V to 3.0V.

Below are a few of the waveforms available.

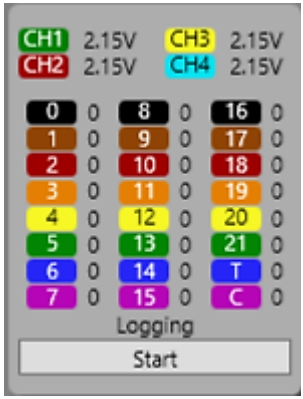




USBEE QX LOGIC PROBE AND DIGITAL VOLTAGE METER

The USBee QX constantly monitors the state of all of the digital inputs and the voltage levels of the CH1 and CH2 inputs. This way you can see the state of the channels even at times you are not capturing waveforms using the Mixed Signal Oscilloscope.

These levels are updated every 500msecs.



USBEE DIGITAL LOGIC THRESHOLD

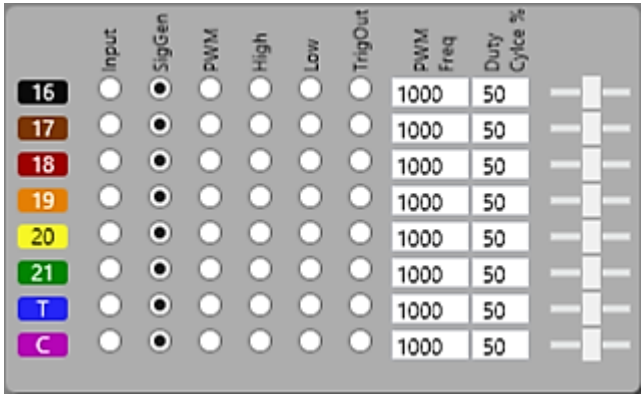
The USBee QX features variable Digital Logic Thresholds that can range from -1V to +2V. Set this logic threshold to define the voltage level that indicates the change from a logic “0” to a logic “1”.

If this level is set incorrectly, or too close to either the top or bottom of your logic range, you will see inconsistent waveforms and this level will need to be adjusted.

USBEE QX DIGITAL SIGNAL GENERATOR

The USBee QX has a Digital Signal Generator built in. It outputs a digital voltage pattern on the **16 through 21 + T and C** signals out the side of the Pod.

To specify what waveform pattern is generated on each of the output signals, you use the section of the USBee QX Control Panel as seen below:



Each of the 8 digital lines can have one of 6 different modes by selecting the associated radio button above:

- The signal line is sampled as an input
- The output of the Arbitrary Digital Signal Generator
- Pulse Width Modulator
- Logic High Level
- Logic Low Level
- Trigger Out signal

The Logic **Low** level outputs 0V on the signal.

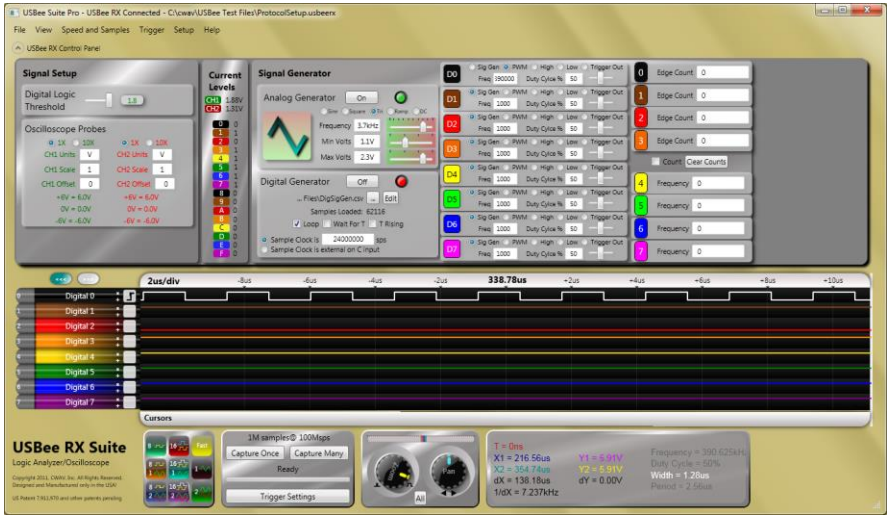
The Logic **High** level outputs 3.3V on the signal.

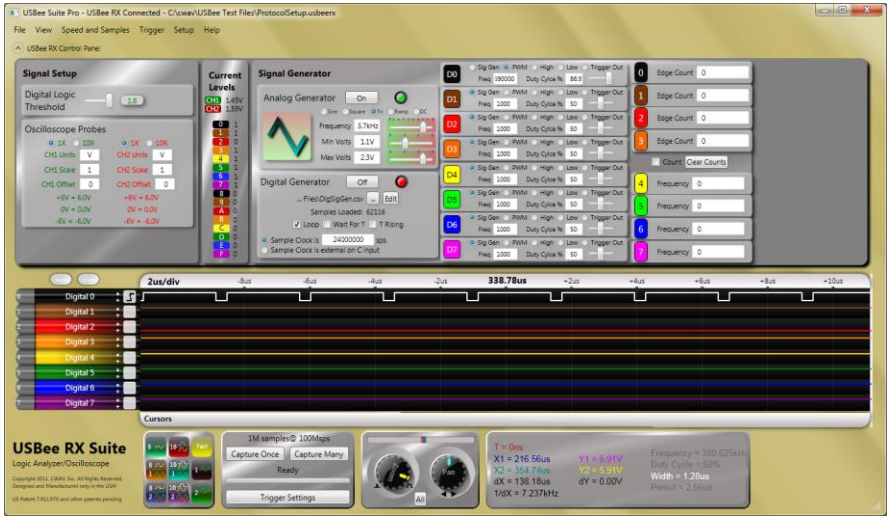
The **Trigger Out** level outputs 0V before the trigger event and 3.3V after the trigger event. This can be used to trigger other equipment to synchronize the captures of data.

PULSE WIDTH MODULATORS

Each digital output channel can be configured as a Pulse Width Modulator. You specify the frequency in Hz (0 to 390000) desired as well as the duty cycle in percent (0 to 100) of the waveform.

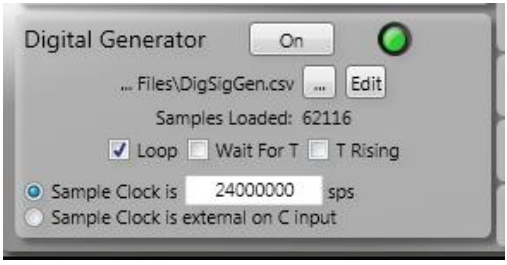
The following shows two examples of a PWM signal with different duty cycles.


USBee Suite Pro - USBee RX Connected - C:\cwav\USBee Test Files\ProtocolSetup.usbeerx
File View Speed and Samples Trigger Setup Help
USBee RX Control Panel
Signal Setup
Digital Logic Threshold
Oscilloscope Probes
Current Levels
Signal Generator
Analog Generator
Digital Generator
2us/div
338.78us
Digital 0
Digital 1
Digital 2
Digital 3
Digital 4
Digital 5
Digital 6
Digital 7
Cursors
USBee RX Suite
Logic Analyzer/Oscilloscope
1M samples@ 100Msps
Capture Once
Capture Many
Ready
Trigger Settings
T = 0ns
X1 = 216.56us
X2 = 354.74us
dX = 138.18us
1/dX = 7.237kHz
Y1 = 5.91V
Y2 = 5.91V
dY = 0.00V


USBee Suite Pro - USBee RX Connected - C:\cwav\USBee Test Files\ProtocolSetup.usbeerx
File View Speed and Samples Trigger Setup Help
USBee RX Control Panel
Signal Setup
Digital Logic Threshold
Oscilloscope Probes
Current Levels
Signal Generator
Analog Generator
Digital Generator
2us/div
338.78us
Digital 0
Digital 1
Digital 2
Digital 3
Digital 4
Digital 5
Digital 6
Digital 7
Cursors
USBee RX Suite
Logic Analyzer/Oscilloscope
1M samples@ 100Msps
Capture Once
Capture Many
Ready
Trigger Settings
T = 0ns
X1 = 216.56us
X2 = 354.74us
dX = 138.18us
1/dX = 7.237kHz
Y1 = 5.91V
Y2 = 5.91V
dY = 0.00V

ARBITRARY DIGITAL PATTERN GENERATOR

Each digital output channel can be configured as an arbitrary digital pattern. You specify the pattern by using e Comma Delimited File (CSV) that specifies the Sample Rate (in Hz – 0 to 100000000) and each of the samples. Each pattern can have from 1 to 65535 samples. A CSV file can be created using a simple text editor, or as an output of a program such as Excel.



SPECIFYING THE PATTERN WITH A CSV FILE

To create a digital pattern, you need to make comma delimited text file. The first item on the first line of the file is the desired sample rate that each of the samples will be clocked out at.

To specify the file to use, select the browse button "…" and choose the file. The file will be parsed and the number of samples loaded and sample rate will be sent to the Digital Signal Generator.

The file format of the CSV files is as follows

```
500000, Sample Rate
23, First sample
51, Second sample
…
84, Last Sample
```

Only the first field of each line is considered as a sample. This allows you to use a spreadsheet that computes the samples in the first column. A sample Excel spreadsheet and the resulting .CSV file is included in the Program Files/CWAV Inc/USBee QX Suite directory for you to use.

For 65535 samples it takes about 30 seconds to download.

Each sample is a decimal value that represents an 8 bit value (from value 0 to 255). These 8 bits are tied to each of the 8 digital outputs: Bit 0 of the sample value goes to the 16 output pin. Bit 7 of the value goes to the C output pin and so on. When the pattern is being generated, all 8 digital outputs are changed at the same time to the 8 digital values represented by the sample value.

For example if the sample value is 85 (55 hex), then at that single sample time the outputs will be (from C to 16) 0, 1, 0, 1, 0, 1, 0, 1.

Since each of the actual output pins can be independently configured to be Sig Gen, PWM, High, Low or Trigger out, you must make sure the channel is set to Sig Gen in order to see the output of the Signal Generator.

SAMPLE CLOCKING

The CSV file specifies the desired sample rate of the clocked out digital samples. You can then modify the sample rate by changing the frequency in the sps text box (from 0 to 100000000).

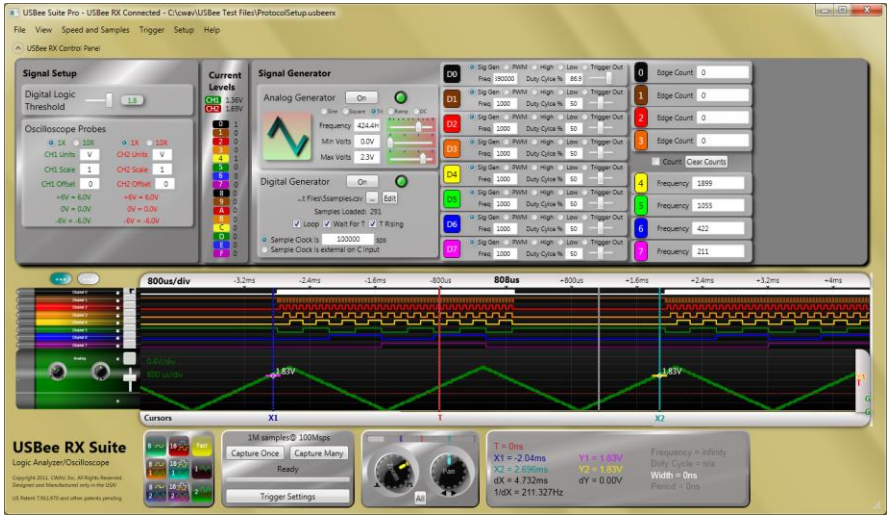
You can also specify to use the external C input as the sample clock by selecting the associated radio button. Make sure you select C as an input in the Signal Generator section. Note that this will reduce your number of digital outputs by 1. Every cycle of the C input will clock out the next sample in the sequence.

WAVEFORM GENERATION CONTROL

The **Wait for T** checkbox (and the associated **T Rising** checkbox to specify the polarity) makes the USBee QX wait for the T input to have an edge before starting the pattern. This allows for synchronizing the pattern generation with an external event. Make sure you select T as an input in the Signal Generator section. Note that this will reduce your number of digital outputs by 1.

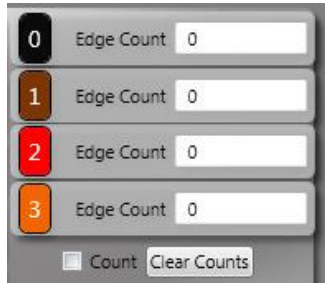
The **Loop** checkbox allows you to loop the generated pattern. If the Wait for T checkbox is selected, each cycle waits for the T to be asserted before starting the generation.

The following screenshot shows the Digital Signal Generator configured to generate 291 samples each time the T signal has a rising edge. In this case the T signal is tied to the CH1 analog signal. The Loop selection makes it repeat, but only after the T signal sees another rising edge. Since the Digital Logic Threshold is set to 1.8V, the T transitions to logic 1 at 1.8V.


USBee Suite Pro - USBee RX Connected - C:\cwav\USBee Test Files\ProtocolSetup.usbeerx
File View Speed and Samples Trigger Setup Help
USBee RX Control Panel
Signal Setup
Digital Logic Threshold
Oscilloscope Probes
Current Levels
Signal Generator
Analog Generator
Digital Generator
Edge Count
Frequency
800us/div
808us
Cursors
X1
T
X2
USBee RX Suite
Logic Analyzer/Oscilloscope
1M samples@ 100Msps
Capture Once
Capture Many
Ready
Trigger Settings

USBEE QX EDGE/PULSE COUNTERS

The USBee QX can independently measure the number of edges that occur on four of the digital input signals (0 through 3). The number of edges counted is shown in the USBee QX Suite control panel as below:

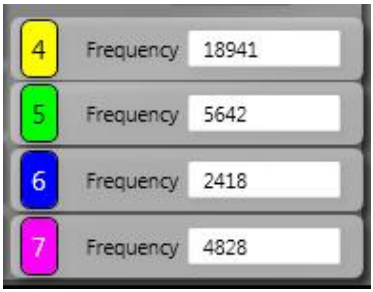


Counting occurs when the **Count** checkbox is selected. To clear the counts, press the **Clear Counts** button. Remember that the counts are affected by the **Digital Logic Threshold** setting, so you must set this correctly for the signals you are measuring for accurate counts.

Since each Pulse is made up of a rising edge and falling edge pair, you can compute the number of pulses by dividing the Number of Edges by 2.

USBEE QX FREQUENCY COUNTERS

The USBee QX can independently measure the frequency of four of the digital input signals (4 through 7). The frequency measured is shown in the USBee QX Suite control panel as below:

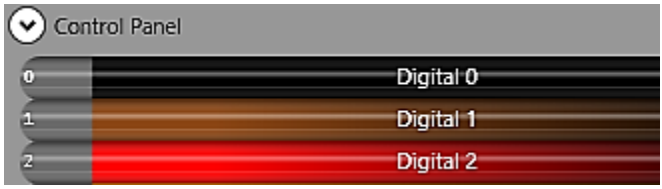


Remember that the measurements are affected by the **Digital Logic Threshold** setting, so you must set this correctly for the signals you are measuring for accurate counts.

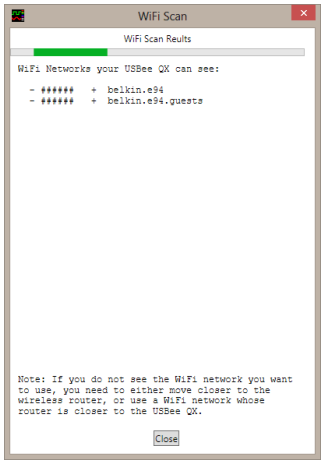
WIFI MODE SETUP

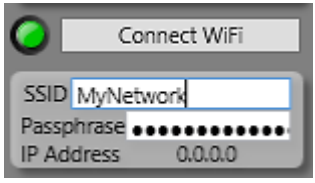
To setup the USBee QX for WiFi operation, you must first connect the pod with the USB cable to a PC with the USBee QX Suite Software installed. For more information, see Software Installation.

Connect the USBee QX first, and then run the USBee QX Suite software. Open up the control panel by clicking the arrow next to the words Control Panel.



Next, type in the SSID of the wireless network that the USBee QX and PC will be networked on. If necessary, type in the passphrase of the network. All network security protocols are supported. Click the Connect WiFi. If you are unsure of the SSID, you can choose the Setup, Scan for WiFi Networks to see a display of the available WiFi networks that are within range of the USBee QX pod.


WiFi Scan
WiFi Scan Reults
WiFi Networks your USBee QX can see:
- ###### + belkin.e94
- ###### + belkin.e94.guests
Note: If you do not see the WiFi network you want to use, you need to either move closer to the wireless router, or use a WiFi network whose router is closer to the USBee QX.
Close



Once you press the Connect WiFi button, the USBee QX Suite software will store the network information in the USBee QX Pod. Next, the USBee QX will attempt to connect to Network. If successful, the USBee QX Suite will display the IP address that was given to the USBee QX. This IP address is stored with the settings of the USBee QX Suite.

It is best if you can use the PC that is intended to connect wirelessly to the USBee QX for this setup, and if they are both on the Network that you want to use so that the IP address can be used for future wireless connections.

A note about IP addresses: your router will assign an address, and that address is valid for at least 24 hours. Every time the USBee QX is powered with the AC adapter, it may receive a new address. The USBee QX Suite software will attempt to connect to the address first, and then search the network for the pod. It is possible that the USBee QX Suite software will be unable to locate the pod on the network and the WiFi setup procedure using the USB cable will have to be repeated.

After successful WiFi setup, close the USBee QX Suite software and unplug the USB cable from the PC and USBee QX. Next, use the supplied AC adapter to power the USBee QX. When the USBee QX detects no USB signal, it will connect to the wireless network. The Wireless LED will illuminate on the case. Now you can run the USBee QX Suite software and perform tests as before.

WiFi data transmissions are substantially slower than USB 3.0 transmissions. As such, you should try to limit the size of your captures to minimize the data download latency.

AUTOMATION

The USBee QX Suite has automation built in that lets you setup your configuration and use it repeatedly to start capture, trigger, export CSV data, export screenshots and exit without user intervention.

To use automation you first need to create a capture file that has all of the configuration and settings you desire. To do this, run the Software, and setup the way you need including triggers, decoding, sample rate/size, search, etc. Finally, Capture, and save this file by using the file menu/Save As and name the file setup.usbeeqx or something similar. It would probably be easiest if you saved this file into the directory where the program is located, ie: "C:\Program Files (x86)\CWAV Inc\USBee QX S

Next, to use automation, open a command prompt and navigate to the above directory and use the following command line format:

"USBee Suite.exe" <intput filename> <output base filename> <flags>

<input filename> is the complete filename including extension that will be loaded and used for capture

<output base filename> is the first part of the output file names that will be generated after the capture is complete

<flags> Letters S, B and/or R indicating S - Save Screenshot JPG file, B - Bus Data to CSV file, or R - Raw Signal data to CSV file

Files that are output are:

- output.usbeeqx Captured USBee QX Suite Trace File
- output.csv Raw Sample CSV file if flag R is included on command line
- outputBus.csv Decoded Bus Data CSV file if flag B is included on command line
- output.jpg Screenshot image file if flag S is included on command line

The GUI will only stay open as long as the capture is not finished. The program will write the files and automatically close.

Below is a batch file that executes a single Capture to a file.

```
echo off
REM  USBee QX Suite Automation

REM  NOTE: Requires USBee QX Suite version 1.3.11 or later

REM  Description: The USBee QX Suite has automation built in that let's you setup your configuration and use
REM  it repeatedly to start capture, trigger, export CSV data, export screenshots and exit without user intervention.
REM  To use automation you first need to create a capture file that has all of the configuration and settings you
REM  desire.  To do this, run the Software, and setup the way you need including triggers, decoding, sample rate/size,
REM  search, etc.  Finally, Capture, and save this file by using the file menu/Save As and name the file setup.usbeeqx
REM  or something similar. It would probably be easiest if you saved this file into the directory where the program
REM  is located, ie: "C:\Program Files (x86)\CWAV Inc\USBee QX Suite\".

REM  Next, to use automation, open a command prompt and navigate to the above directory and use the following
REM  command line format:

REM      "USBee Suite.exe <intput filename> <output base filename> <flags>"

REM  <input filename> is the complete filename including extension that will be loaded and used for capture
REM  <output base filename> is the first part of the output file names that will be generated after the capture is complete
REM  <flags> Letters S, B and/or R indicating S - Save Screenshot JPG file, B - Bus Data to CSV file, or R - Raw Signal data to CSV file

REM  Files that are output are:
REM        output.usbeeqx - Captured USBee QX Suite Trace File
REM        output.csv     - Raw Sample CSV file if flag R is included on command line
REM        outputBus.csv  - Decoded Bus Data CSV file if flag B is included on command line
REM        output.jpg     - Screenshot image file if flag S is included on command line

REM  GUI will only stay open as long as the capture is not finished. The program will write the files and
REM  automatically close.

REM  Below is the actual command line call to load the setup.usbeeqx file, perform a capture and save the capture file and a screenshot.

"USBee Suite.exe" setup.usbeeqx output S

pause.
```

USBEE QX TOOLBUILDER

OVERVIEW

The USBee QX Test Pod System consists of the USBee QX Test Pod connected to a Windows® PC SuperSpeed 3.0 or High Speed USB 2.0 port through the USB cable, and to your circuit using the multicolored test leads and clips. Once connected and installed, the USBee can then be controlled using either the USBee QX Suite Windows Software or your own USBee QX Toolbuilder software.

The USBee QX Test Pod is ideal for students or designers that need to get up and running with Super Speed USB immediately. With a USB connector on one end and signal pin headers on the other, this simple pod will instantly USB 3.0 Super-Speed enable your design. Then using the source code libraries, drivers and DLL's that are included you can write your own PC application to control and monitor the signal pins on the pod.

SYSTEM SOFTWARE ARCHITECTURE

The USBee QX Pod is controlled through a set of Windows DLL function calls. These function calls are defined in following sections and provide initialization and data transfer routines. This DLL can be called using a variety of languages, including Visual BASIC, C, C++, etc. We have included a sample application in C and VB that show how you can use the calls to setup and control the pod. You can port this example to any language that can call DLL functions (C#, Delphi, Lab View, …)

After installing the USBee QX Suite software on your computer, you can then plug in the USBee QX pod. Immediately after plugging in the pod, the operating system finds the INF file installed during installation. This file specifies which driver to load for that device, which is the Windows provided WINUSB driver. This driver then remains resident in memory until you unplug the device.

Once you run your USBee Toolbuilder application, it will call the functions in the USBEEADVSTE.DLL file which is installed in the \Windows\System32 directory for 32-bit Windows, or \Windows\SysWOW directory for 64-bit windows. This DLL will then make the correct calls to the WINUSB driver to perform the USB transfers that are required by the pod.

Both example projects are built using Microsoft Visual Studio 2010 which can be downloaded from the Microsoft web site.

INSTALLING THE USBEE QX TOOLBUILDER

The USBee QX Toolbuilder software is included as part of the installation with the USBee QX Suite software and can be downloaded from www.usbee.com. Run the setup.exe install program in the downloaded file to install from the web. The install program will install the following USBee Toolbuilder files and drivers into their correct location on your system. Other files will also be installed, but are not necessary for Toolbuilder operation.

USBEE QX TOOLBUILDER PROJECTS

The USBee QX example Toolbuilder projects are located in

\Program Files\USBee QX Suite\USBee QX Toolbuilder\USBeeQXToolbuilderInC , and

\Program Files\USBee QX Suite\USBee QX Toolbuilder\USBeeQXToolbuilderInVB

The USBee QX Toolbuilder depends on the files in the directories for proper operation, so if you want to relocate the projects to somewhere else, you must maintain the entire file/directory structure.

USBEE QX TOOLBUILDER FUNCTIONS

This section details the functions that are available in the usbeeadvste.dll and defines the parameters to each call. The calling conventions are shown for the C language, but you can find the definitions for Visual Basic in the example file as well.

INITIALIZING THE USBEE QX POD

INITIALIZEQX

This routine initializes the USBee QX Pod. This routine must be called before calling any other USBee QX functions.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API InitializeQX( void );
```

Return Value:

0 = Pod Not Found

1 = Pod Initialized

SETLOGICTHRESHOLDQX – SETTING THE DIGITAL LOGIC THRESHOLD

This routine sets the digital logic threshold for all of the digital inputs.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API SetLogicThresholdQX( float Thresh  );
```

where `Thresh` is the voltage threshold from -1.0 to 2.0. Digital inputs below this threshold will be interpreted as a logic 0 and voltages above this threshold will be interpreted as a logic 1.

Return Value:

- 1 = Successful
- 0 = Failure

SETANALOGCHANNELSETTINGS – SETTING THE ANALOG CHANNELS

This routine sets the analog channel input settings.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API SetAnalogChannelSettings( unsigned long
channel,  float range, unsigned long DCCoupled  );
```

- **channel** is which analog channel 1 = CH1, 2 = CH2, 3 = CH3, 4 = CH4
- **range** is the input measured range. Using the smallest range for your input signal gives the highest resolution measurements.
    - 0.75 = +/-0.75V (probe switch must be set at 1x)
    - 1.5 = +/-1.5V (probe switch must be set at 1x)
    - 3 = +/-3V (probe switch must be set at 1x)
    - 6 = +/-6V (probe switch must be set at 1x)
    - 7.5 = +/-7.5V (probe switch must be set at 10x)
    - 15 = +/-15V (probe switch must be set at 10x)
    - 30 = +/-30V (probe switch must be set at 10x)
    - 60 = +/-60V (probe switch must be set at 10x)
- **DCCoupled** sets the coupling for that channel. 0 = AC coupled, 1 = DC coupled

Return Value:

- 1 = Successful
- 0 = Failure

POWERONANALOGQX – TURNING ON POWER TO THE ANALOG CHANNELS

This routine turns on the power to all of the analog channels. This uses the maximum current of the device, so turn off the Analog Channel power when not in use to reduce power consumption and heat.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API PowerOnAnalogQX();
```

Return Value:

- 1 = Successful
- 0 = Failure

POWEROFFANALOGQX – TURNING OFF POWER TO THE ANALOG CHANNELS

This routine turns off the power to all of the analog channels. The Analog channels uses the maximum current of the device, so turn off the Analog Channel power when not in use to reduce power consumption and heat.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API PowerOffAnalogQX();
```

Return Value:

- 1 = Successful
- 0 = Failure

ANALOGLIVEVOLTAGE – READING THE VOLTAGE ON THE ANALOG CHANNELS

This routine reads the voltage on an analog channel.

Calling Convention

```
CWAV_IMPORT float CWAV_API AnalogLiveVoltage( unsigned long channel );
```

- **channel** is which analog channel 1 = CH1, 2 = CH2, 3 = CH3, 4 = CH4

READING AND SETTING SIGNAL STATES

SETSIGNALSQX - SETTING THE USBEE QX OUTPUT SIGNALS

This routine sets the digital output state of the 8 digital outputs available on the digital channels 16 thru 21 and T and C.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API SetSignalsQX( unsigned long mask,
unsigned long value  );
```

- **mask** is the mask for setting each of the 8 USBee digital Output signals (16 through 21 and T and C). A signal is not changed if the corresponding bit is a 0. A signal is changed if the corresponding bit is a 1. Channel 16 is bit 0 (lsb) and C is bit 7.
- **value** is the digital level driven on the output signals. A signal is driven high (2.5V) if the corresponding bit is a 1. A signal is driven low (0V) if the corresponding bit is a 0. Channel 16 is bit 0 (lsb) and C is bit 7.

Return Value:

- 1 = Successful
- 0 = Failure

GETDIGITALSIGNALSQX - READING THE USBEE QX INPUT SIGNALS

This routine gets the current value of the digital input signals.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API GetDigitalSignalsQX( unsigned char
*digital0to7, unsigned char *digital8to15, unsigned char *digital16toC );
```

- After this call, the variable pointed to by **digital0to7** will hold the digital logic value read on the input signals 0 through 7.
- After this call, the variable pointed to by **digital8to15** will hold the digital logic value read on the input signals 8 through 15.
- After this call, the variable pointed to by **digital16toC** will hold the digital logic value read on the input signals 16 through C.

Return Value:

- 1 = Successful
- 0 = Failure

GENERATEANALOGWAVEFORMQX – CONTROLLING THE AOUT SIGNAL

This routine sets up the Analog waveform generator that produces a waveform on the AOUT signal.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API GenerateAnalogWaveformQX( unsigned long
SamplesPerSecond, unsigned char SamplesPerCycle, unsigned char *samples );
```

- **SamplesPerSecond** is the sample rate of the output samples and ranges from 1 to 300,000.
- **SamplesPerCycle** is the number of samples that make up a complete cycle in the analog waveform and ranges from 1 to 128 samples.
- **samples** points to a buffer of samples. Each sample is a digital value representing the analog output voltage using the formula Vout = samples / 61.429. Vout range is from 0 to 3.0V.

Return Value:

- 1 = Successful

LOGIC ANALYZER AND OSCILLOSCOPE FUNCTIONS

The following API describes the routines that control the Logic Analyzer and Oscilloscope functionality of the USBee QX Test Pod.

STARTCAPTUREQX

This routine starts the pod capturing data at the specified trigger and sample rates.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API StartCaptureQX( unsigned long
buffersize, unsigned char TriggerPosition, float SampleRate, unsigned long
channelmaskA, unsigned long channelmaskB, unsigned char ExternalClockingOn,
unsigned char CompressionOn  );
```

- Buffersize is how many 64-bit samples are taken and ranges from 65536 to 33554432.
- TriggerPosition what percent of the buffer should be prestored before the trigger
- channelmaskA represent which samples to take:
    - Bit 0: 1 = Sample Digital 0 signal, 0 = ignore this channel
    - Bit 1: 1 = Sample Digital 1 signal, 0 = ignore this channel
    - Etc.
    - Bit 15: 1 = Sample Digital F signal, 0 = ignore this channel
    - Bit 16-23: 255 = Sample Analog channel 1, 0 = ignore analog channel 1
    - Bit 24-31: 255 = Sample Analog channel 2, 0 = ignore analog channel 2
- channelmaskB represent which samples to take:
    - Bit 0: 1 = Sample Digital 16 signal, 0 = ignore this channel
    - Bit 1: 1 = Sample Digital 17 signal, 0 = ignore this channel
    - Etc.
    - Bit 5: 1 = Sample Digital 21 signal, 0 = ignore this channel
    - Bit 6: 1 = Sample Digital T signal, 0 = ignore this channel
    - Bit 7: 1 = Sample Digital C signal, 0 = ignore this channel
    - Bit 8-15: 255 = Sample Analog channel 3, 0 = ignore analog channel 3
    - Bit 16-23: 255 = Sample Analog channel 4, 0 = ignore analog channel 4
    - Bit 24-31: 0 = reserved
- SampleRate is how many samples per second to capture. Valid rates are in units of samples per second ranging from 10 to 100,000,000.
- ExternalClockOn specifies whether to use the external clock input pin “C”to capture samples (1) , or the internal sample clock as specified above (0).
- CompressionOn specifies whether to use sample compression (1) or not (0).

Return Value:

- 0 = Failed
- 1 = Success

CAPTURESTATUSQX

This routine checks the status of the data capture in progress.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API CaptureStatusQX( unsigned char *Full,
unsigned char *Triggered, unsigned char *Running );
```

- Running: 1 = Acquisition is still running, 0 = Acquisition has completed
- Triggered: 1 = Trigger has occurred, 0 = still waiting for the trigger
- Full: The percentage of the buffer that is currently filled. Ranges from 0 to 100.

Return Value:

- 0 = Failed
- 1 = Success

STOPCAPTUREQX

This routine terminates a pending capture and discards the sample data.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API StopCaptureQX( void );
```

Return Value:

- 1 = Capture Stopped
- 0 = Stop Failed

TRIGGERNOWQX

This routine immediately triggers a pending capture.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API TriggerNowQX( void );
```

Return Value:

- 1 = Trigger Occurred
- 0 = Trigger Failed

ENDCAPTUREQX

This routine completes the capture and transfers all of the stored data to the PC. This routine should be called once a capture is completed (CaptureStatusQX Running is 0).

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API EndCaptureQX( __int64
*ActualNumberOfSamples, __int64 *TriggerPosition);
```

- ActualNumberOfSamples specifies how many samples were captured at the given sample rate
- TriggerPosisition specifies which sample in the captured buffer contains the trigger event referenced from the beginning of the samples.

Return Value:

- 1 = End successful
- 0 = Trigger Failed

SAMPLEDIGITALDATA

This routine returns the digital signals of a particular sample.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API SampleDigitalData( __int64 index );
```

- Index: sample number to return

Return Value:

Value of all of the channels of the given sample. The low 3 bytes contain the 24 digital channels (0 thru 21 and T and C).

ANALOGSAMPLEVOLTAGE

This routine returns the analog voltage of a particular sample.

Calling Convention

```
CWAV_IMPORT float CWAV_API AnalogSampleVoltage( unsigned long channel,
__int64 index );
```

- Channel: which analog channel to return (1, 2, 3 or 4)
- Index: sample number to return

Return Value:

The voltage at that sample in Volts.

FINDNEXTEDGE

This routine scans through the sample buffer and finds the next edge on a given channel. This routine should be used in the cases of compressed data instead of individual SampleDigitalData calls.

Calling Convention

```
CWAV_IMPORT __int64 CWAV_API FindNextEdge( __int64 UCSample, unsigned long
long channelmask, unsigned long direction );
```

UCSample is the sample number at which to start looking for an edge.

Channelmask is which channels to look for an edge on. A 1 in a bit position specifies to use that channel. Bit 0 = digital channel 0, Bit 15 = digital channel 15.

Direction specifies forward (1) in time, or backward (0) in time.

Return Value:

Sample number where the edge was found.

SETTRIGGERSQX

This routine sets the trigger condition to use during the next capture.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API SetTriggersQX( int TrigXEnabled, int
TrigYEnabled, int TrigXorYEnabled, int TrigXandYEnabled, int
TrigXthenYEnabled, int TrigYthenXEnabled,

                  int TrigX_DigitalEdgeEnabled, int
TrigX_AnalogEdgeEnabled, int TrigX_QualifyDigitalEnabled, int
TrigX_QualifyAnalogEnabled, int TrigX_QualifyTimeEnabled,
                  int TrigX_InvertDigitalQualifierEnabled, int
TrigX_InvertAnalogQualifierEnabled, int TrigX_InvertTimeQualifierEnabled,
int TrigX_DigitalEdgeChannel,
                  int TrigX_DigitalEdgeRising,  int
TrigX_AnalogEdgeChannel, int TrigX_AnalogEdgeRising, int
TrigX_AnalogQualifierChannel, int TrigX_AnalogQualifierFrom,
                  int TrigX_AnalogQualifierTo, int
TrigX_AnalogTriggerLevel, long TrigX_DigitalQualifierChannelMask, long
TrigX_DigitalQualifierFrom, long TrigX_DigitalQualifierTo,
```

```
                int TrigY_DigitalEdgeEnabled, int
TrigY_AnalogEdgeEnabled, int TrigY_QualifyDigitalEnabled, int
TrigY_QualifyAnalogEnabled, int TrigY_QualifyTimeEnabled,
                int TrigY_InvertDigitalQualifierEnabled, int
TrigY_InvertAnalogQualifierEnabled, int TrigY_InvertTimeQualifierEnabled,
int TrigY_DigitalEdgeChannel,
                int TrigY_DigitalEdgeRising,  int
TrigY_AnalogEdgeChannel, int TrigY_AnalogEdgeRising, int
TrigY_AnalogQualifierChannel, int TrigY_AnalogQualifierFrom,
                int TrigY_AnalogQualifierTo, int
TrigY_AnalogTriggerLevel, long TrigY_DigitalQualifierChannelMask, long
TrigY_DigitalQualifierFrom, long TrigY_DigitalQualifierTo

                );
```

- TriggerYEnabled: 1 = Trigger when Trig Y is present
- TriggerXEnabled: 1 = Trigger when Trig X is present
- TrigXorYEnabled: 1 = Trigger when Trig X or Y is present
- TrigXandYEnabled: 1 = Trigger when Trig X and Y is present
- TrigXthenYEnabled: 1 = Trigger when Trig X followed by Y is present
- TrigYthenXEnabled: 1 = Trigger when Trig Y followed by X is present

Return Value:

- 1 = Trigger Set successful
- 0 = Trigger Set Failed

DECODEUSB

This routine decodes bus traffic and outputs the data to an output file. This routine works on a sample buffer captured using the StartCapture routine.

Calling Convention

```
CWAV_IMPORT int CWAV_API DecodeUSB (unsigned __int64*reserved1, unsigned
char *OutFilename, unsigned char *InlineFilename, __int64 StartSample,
__int64 EndSample, long ShowEndpoint, long ShowAddress, long DPlus, long
DMinus, long Speed, long Rate, long SOF, long delimiter, long showall, long
hex,   char *ProtocolDefinitionFilename, char *ProtocolOutputFilename, char
*ErrorString);
```

- OutFilename: pointer to the filename string to write the decoded data to.
- StartSample: the index of the first sample to start decoding
- EndSample: the index of the last sample to decode
- ShowEndpoint: 999 = show all traffic, otherwise show only this USB endpoint number traffic
- ShowAddress: 999 = show all USB devices, otherwise only show the USB device with this USB address
- DPlus: Which signal (0 – 15) to use for the D Plus signal

- DMinus: Which signal (0 – 15) to use for the D Minus signal
- Speed: 0 = Low Speed USB, 1 = Full Speed USB
- Rate is as follows:
    - 69 = 600 Msps
    - 39 = 300 Msps
    - 29 = 200 Msps
    - 108 = 100 Msps
    - 58 = 50 Msps
    - 28 = 20 Msps
    - 107 = 10 Msps
    - 57 = 5 Msps
    - 27 = 2Msps
    - 106 = 1 Msps
    - 56 = 500ksps
    - 26 = 200ksps
    - 105 = 100ksps
- SOF: 0 = do not show the SOF (Start of Frames), 1 = show SOFs
- Delimeter: 0 = no delimiter, 1 = Comma delimeter, 2 = Space delimeter
- Showall: 0 = Only show the data payload, 1 = show all packet details
- Hex: 0 = display data in decimal, 1 = display data in hex
- ProtocolDefinitionFilename – filename for the Protocol Definition File to use to create a PacketPresenter file. If this value is 0 then the PacketPresenter feature is turned off.
- ProtocolOutputFilename – filename that is created for the output of the PacketPresenter.
- ErrorString – string that holds an error description of the routine returns an error.

Return Value:

- TRUE – No Error during processing
- FALSE – Error while processing. The ErrorString contains a description of the error to present to the user.

DECODESPI

This routine decodes bus traffic and outputs the data to an output file. This routine works on a sample buffer captured using the StartCapture routine.

Calling Convention

```
CWAV_IMPORT int CWAV_API DecodeSPIVariable (unsigned __int64 *reserved1,
unsigned char *OutFilename,unsigned char *InlineMOSIFilename,unsigned char
*InlineMISOFilename, __int64 StartSample, __int64 EndSample, long Rate,
unsigned long SS,unsigned long SCK,unsigned long tMOSI,unsigned long tMISO,
unsigned long MISOEdge,unsigned long MOSIEdge, unsigned long
delimiter,unsigned long hex,unsigned long UseSS, unsigned long SSLevel,
long BytesPerLine, long BitsPerByte, char *ProtocolDefinitionFilename, char
*ProtocolOutputFilename, char *ErrorString);
```

- OutFilename: pointer to the filename string to write the decoded data to.
- StartSample: the index of the first sample to start decoding
- EndSample: the index of the last sample to decode
- Rate is as follows:
    - 69 = 600 Msps
    - 39 = 300 Msps
    - 29 = 200 Msps
    - 108 = 100 Msps
    - 58 = 50 Msps
    - 28 = 20 Msps
    - 107 = 10 Msps
    - 57 = 5 Msps
    - 27 = 2Msps
    - 106 = 1 Msps
    - 56 = 500ksps
    - 26 = 200ksps
    - 105 = 100ksps
- SS: Which signal (0 – 15) to use for the Slave Select signal
- SCK: Which signal (0 – 15) to use for the clock signal
- MISO: Which signal (0 – 15) to use for the MISO signal
- MOSI: Which signal (0 – 15) to use for the MOSI signal
- MOSIEdge: 0 = use falling edge of SCK to sample data on MOSI, 1 = use rising edge
- MISOEdge: 0 = use falling edge of SCK to sample data on MISO, 1 = use rising edge
- Delimeter: 0 = no delimiter, 1 = Comma delimeter, 2 = Space delimeter
- Showall: 0 = Only show the data payload, 1 = show all packet details
- Hex: 0 = display data in decimal, 1 = display data in hex
- UseSS: 0 = don't use an SS signal, 1 = use the SS signal
- BytesPerLine: How many output words are on each output line.
- ProtocolDefinitionFilename – filename for the Protocol Definition File to use to create a PacketPresenter file. If this value is 0 then the PacketPresenter feature is turned off.
- ProtocolOutputFilename – filename that is created for the output of the PacketPresenter.
- ErrorString – string that holds an error description of the routine returns an error.

Return Value:

- TRUE – No Error during processing
- FALSE – Error while processing. The ErrorString contains a description of the error to present to the user.

DECODEI2C

This routine decodes bus traffic and outputs the data to an output file. This routine works on a sample buffer captured using the StartCapture routine.

Calling Convention

```
CWAV_IMPORT int CWAV_API DecodeI2C (unsigned __int64 *reserved1, unsigned
char *OutFilename, unsigned char *InlineSDAFilename, __int64 StartSample,
__int64 EndSample, long Rate, unsigned long SDA, unsigned long SCL, long
showack, long delimiter, long showall, long hex, char
*ProtocolDefinitionFilename, char *ProtocolOutputFilename, char
*ErrorString);
```

- OutFilename: pointer to the filename string to write the decoded data to.
- StartSample: the index of the first sample to start decoding
- EndSample: the index of the last sample to decode
- Rate is as follows:
    - 69 = 600 Msps
    - 39 = 300 Msps
    - 29 = 200 Msps
    - 108 = 100 Msps
    - 58 = 50 Msps
    - 28 = 20 Msps
    - 107 = 10 Msps
    - 57 = 5 Msps
    - 27 = 2Msps
    - 106 = 1 Msps
    - 56 = 500ksps
    - 26 = 200ksps
    - 105 = 100ksps
- SDA: Which signal (0 – 15) to use for the SDA signal
- SCL: Which signal (0 – 15) to use for the SCL signal
- ShowAck: 0 = Do not show each byte ACK values, 1 = show the ACK value after each byte
- Delimeter: 0 = no delimiter, 1 = Comma delimeter, 2 = Space delimeter
- Showall: 0 = Only show the data payload, 1 = show all packet details
- Hex: 0 = display data in decimal, 1 = display data in hex
- ProtocolDefinitionFilename – filename for the Protocol Definition File to use to create a PacketPresenter file. If this value is 0 then the PacketPresenter feature is turned off.
- ProtocolOutputFilename – filename that is created for the output of the PacketPresenter.
- ErrorString – string that holds an error description of the routine returns an error.

Return Value:

- TRUE – No Error during processing
- FALSE – Error while processing. The ErrorString contains a description of the error to present to the user.

DECODECAN

This routine decodes bus traffic and outputs the data to an output file. This routine works on a sample buffer captured using the StartCapture routine.

Calling Convention

```
CWAV_IMPORT int CWAV_API DecodeCAN (unsigned __int64 *reserved1, unsigned
char *OutFilename, unsigned char *OutFilename, __int64 StartSample, __int64
EndSample, unsigned long Rate, unsigned long Channel, unsigned long
BitRate, unsigned long maxID, unsigned long minID, long delimiter, long
showall, long Phex, char *ProtocolDefinitionFilename, char
*ProtocolOutputFilename, char *ErrorString);
```

- OutFilename: pointer to the filename string to write the decoded data to.
- StartSample: the index of the first sample to start decoding
- EndSample: the index of the last sample to decode
- Rate is as follows:
    - 69 = 600 Msps
    - 39 = 300 Msps
    - 29 = 200 Msps
    - 108 = 100 Msps
    - 58 = 50 Msps
    - 28 = 20 Msps
    - 107 = 10 Msps
    - 57 = 5 Msps
    - 27 = 2Msps
    - 106 = 1 Msps
    - 56 = 500ksps
    - 26 = 200ksps
    - 105 = 100ksps
- Channel: Which signal (0 – 15) to use for the CAN signal
- BitRate: The value of the bit rate in bits per second (for 250kbps use 250000)
- MaxID: 0 = show all packets, otherwise this is the maximum ID to display
- MinID: 0 = show all packets, otherwise this is the minimum ID to display
- Delimeter: 0 = no delimiter, 1 = Comma delimeter, 2 = Space delimeter
- Showall: 0 = Only show the data payload, 1 = show all packet details
- PHex: 0 = display data in decimal, 1 = display data in hex
- ProtocolDefinitionFilename – filename for the Protocol Definition File to use to create a PacketPresenter file. If this value is 0 then the PacketPresenter feature is turned off.
- ProtocolOutputFilename – filename that is created for the output of the PacketPresenter.
- ErrorString – string that holds an error description of the routine returns an error.

Return Value:

- TRUE – No Error during processing
- FALSE – Error while processing. The ErrorString contains a description of the error to present to the user.

DECODE1WIRE

This routine decodes bus traffic and outputs the data to an output file. This routine works on a sample buffer captured using the StartCapture routine.

Calling Convention

```
CWAV_IMPORT int CWAV_API Decode1Wire (unsigned __int64 *reserved1, unsigned
char *OutFilename, unsigned char *InlineFilename, _int64 StartSample,
__int64 EndSample, long Rate, unsigned long Signal, long delimiter, long
showall, long hex, char *ProtocolDefinitionFilename, char
*ProtocolOutputFilename, char *ErrorString);
```

- OutFilename: pointer to the filename string to write the decoded data to.
- StartSample: the index of the first sample to start decoding
- EndSample: the index of the last sample to decode
- Rate is as follows:
    - 69 = 600 Msps
    - 39 = 300 Msps
    - 29 = 200 Msps
    - 108 = 100 Msps
    - 58 = 50 Msps
    - 28 = 20 Msps
    - 107 = 10 Msps
    - 57 = 5 Msps
    - 27 = 2Msps
    - 106 = 1 Msps
    - 56 = 500ksps
    - 26 = 200ksps
    - 105 = 100ksps
- Signal: Which signal (0 – 15) to use for the 1-Wire signal
- Delimeter: 0 = no delimiter, 1 = Comma delimeter, 2 = Space delimeter
- Showall: 0 = Only show the data payload, 1 = show all packet details
- Hex: 0 = display data in decimal, 1 = display data in hex
- ProtocolDefinitionFilename – filename for the Protocol Definition File to use to create a PacketPresenter file. If this value is 0 then the PacketPresenter feature is turned off.
- ProtocolOutputFilename – filename that is created for the output of the PacketPresenter.
- ErrorString – string that holds an error description of the routine returns an error.

Return Value:

- TRUE – No Error during processing
- FALSE – Error while processing. The ErrorString contains a description of the error to present to the user.

DECODEPARALLEL

This routine decodes bus traffic and outputs the data to an output file. This routine works on a sample buffer captured using the StartCapture routine.

Calling Convention

```
CWAV_IMPORT int CWAV_API DecodeParallel (unsigned __int64 *reserved1,
unsigned char *OutFilename, unsigned char *InlineFilename, __int64
StartSample, __int64 EndSample, long Rate, unsigned long Channels,unsigned
long Clock, unsigned long UseCLK, long CLKEdge, unsigned long delimiter,
unsigned long hex, long BytesPerLine, char *ProtocolDefinitionFilename,
char *ProtocolOutputFilename, char *ErrorString);
```

- OutFilename: pointer to the filename string to write the decoded data to.
- StartSample: the index of the first sample to start decoding
- EndSample: the index of the last sample to decode
- Rate is as follows:
    - 69 = 600 Msps
    - 39 = 300 Msps
    - 29 = 200 Msps
    - 108 = 100 Msps
    - 58 = 50 Msps
    - 28 = 20 Msps
    - 107 = 10 Msps
    - 57 = 5 Msps
    - 27 = 2Msps
    - 106 = 1 Msps
    - 56 = 500ksps
    - 26 = 200ksps
    - 105 = 100ksps
- Channels: Bit mask which represents which signals are part of the parallel data bus. Bit 0 is Pod signal 0. Bit 15 is pod signal F.
- Clock: Which signal (0 – 15) to use for the clock signal
- UseCLK: 0 – don't use the Clock signal above, 1 – use the Clock signal above to qualify the samples
- CLKEdge: 0 = use falling edge of the Clock to sample data, 1 = use rising edge
- Delimeter: 0 = no delimiter, 1 = Comma delimeter, 2 = Space delimeter
- Showall: 0 = Only show the data payload, 1 = show all packet details
- Hex: 0 = display data in decimal, 1 = display data in hex
- BytesPerLine: How many output words are on each output line.
- ProtocolDefinitionFilename – filename for the Protocol Definition File to use to create a PacketPresenter file. If this value is 0 then the PacketPresenter feature is turned off.
- ProtocolOutputFilename – filename that is created for the output of the PacketPresenter.

- ErrorString – string that holds an error description of the routine returns an error.

Return Value:

- TRUE – No Error during processing
- FALSE – Error while processing. The ErrorString contains a description of the error to present to the user.

DECODESERIAL

This routine decodes bus traffic and outputs the data to an output file. This routine works on a sample buffer captured using the StartCapture routine.

Calling Convention

```
CWAV_IMPORT int CWAV_API DecodeSerial (unsigned __int64 *reserved1,
unsigned char *OutFilename, unsigned char *InlineFilename, __int64
StartSample, __int64 EndSample, unsigned long Rate, unsigned long
Channel,unsigned long AlignValue, unsigned long AlignEdge, unsigned long
AlignChannel,unsigned long UseAlignChannel, unsigned long
ClockChannel,unsigned long ClockEdge, unsigned long BitsPerValue, unsigned
long MSBFirst, unsigned long delimiter,unsigned long hex, long
BytesPerLine, char *ProtocolDefinitionFilename, char
*ProtocolOutputFilename, char *ErrorString);
```

- OutFilename: pointer to the filename string to write the decoded data to.
- StartSample: the index of the first sample to start decoding
- EndSample: the index of the last sample to decode
- Rate is the rate at which samples were taken during StartCapture:
    - 69 = 600 Msps
    - 39 = 300 Msps
    - 29 = 200 Msps
    - 108 = 100 Msps
    - 58 = 50 Msps
    - 28 = 20 Msps
    - 107 = 10 Msps
    - 57 = 5 Msps
    - 27 = 2Msps
    - 106 = 1 Msps
    - 56 = 500ksps
    - 26 = 200ksps
    - 105 = 100ksps
- Channel: Which signal (0 – 15) to use for the serial signal
- AlignValue: When using word aligning, bus value which is used for aligning the serial stream to byte boundaries.
- AlignEdge: When using an external signal for aligning, 0 = falling edge, 1 = rising edge.
- AlignChannel: When using an external signal for aligning, which signal (0 – 15) to use for the align signal

- UseAlignChannel: 0 = use word aligning, 1 = use external align signal
- ClockChannel: Which signal (0 – 15) to use for the clock signal
- CLKEdge: 0 = use falling edge of the Clock to sample data, 1 = use rising edge
- BitsPerValue: how many bits are in each word of the serial stream
- MSBFirst: 0 = LSBit is sent first, 1 = MSBit is sent first
- Delimeter: 0 = no delimiter, 1 = Comma delimeter, 2 = Space delimeter
- Showall: 0 = Only show the data payload, 1 = show all packet details
- Hex: 0 = display data in decimal, 1 = display data in hex
- BytesPerLine: How many output words are on each output line.
- ProtocolDefinitionFilename – filename for the Protocol Definition File to use to create a PacketPresenter file. If this value is 0 then the PacketPresenter feature is turned off.
- ProtocolOutputFilename – filename that is created for the output of the PacketPresenter.
- ErrorString – string that holds an error description of the routine returns an error.

Return Value:

- TRUE – No Error during processing
- FALSE – Error while processing. The ErrorString contains a description of the error to present to the user.

DECODEASYNC

This routine decodes bus traffic and outputs the data to an output file. This routine works on a sample buffer captured using the StartCapture routine.

Calling Convention

```
CWAV_IMPORT int CWAV_API DecodeASYNC (unsigned __int64 *reserved1, unsigned
char *OutFilename,unsigned char *OutTxFilename, unsigned char
*OutRxFilename, __int64 StartSample, __int64 EndSample, long Rate, unsigned
long TxChannel, unsigned long RxChannel, unsigned long BaudRate, unsigned
long Parity, unsigned long DataBits, unsigned long Invert, unsigned long
delimiter, unsigned long hex, unsigned long ascii, long BytesPerLine, char
*ProtocolDefinitionFilename, char *ProtocolOutputFilename, char
*ErrorString);
```

- OutFilename: pointer to the filename string to write the decoded data to.
- StartSample: the index of the first sample to start decoding
- EndSample: the index of the last sample to decode
- Rate is the rate at which samples were taken during StartCapture:
    - 69 = 600 Msps
    - 39 = 300 Msps
    - 29 = 200 Msps
    - 108 = 100 Msps
    - 58 = 50 Msps
    - 28 = 20 Msps
    - 107 = 10 Msps
    - 57 = 5 Msps

    - 27 = 2Msps
    - 106 = 1 Msps
    - 56 = 500ksps
    - 26 = 200ksps
    - 105 = 100ksps
- TX and RX Channels: Bit mask which represents which signal to decode. Bit 0 is Pod signal 0. Bit 15 is pod signal F.
- BaudRate: Baud Rate in bits per second (19.2K = 19200)
- Parity: 0 = No parity, 1 = Mark, 2 = Space, 3 = Even, 4 = Odd, 5 = Ignore
- DataBits: Number of data bits (4 to 24)
- Delimeter: 0 = no delimiter, 1 = Comma delimeter, 2 = Space delimeter
- Showall: 0 = Only show the data payload, 1 = show all packet details
- Invert: 1 = invert the logic of the signal before processing
- Hex: 0 = display data in decimal, 1 = display data in hex
- ASCII: 0 = show byte values, 1 = show ASCII equivalent
- BytesPerLine: How many output words are on each output line.
- ProtocolDefinitionFilename – filename for the Protocol Definition File to use to create a PacketPresenter file. If this value is 0 then the PacketPresenter feature is turned off.
- ProtocolOutputFilename – filename that is created for the output of the PacketPresenter.
- ErrorString – string that holds an error description of the routine returns an error.

Return Value:

- TRUE – No Error during processing
- FALSE – Error while processing. The ErrorString contains a description of the error to present to the user.

DECODESETNAME

This routine sets the string that is output during any of the above decoders and can represent a unique identifier for that bus.

Calling Convention

```
CWAV_IMPORT int CWAV_API DecodeSetName (char *name);
```

DIGITAL PATTERN GENERATOR FUNCTIONS

The following API describes the routines that control the digital pattern generator functionality of the USBee QX Test Pod.

GENERATEPWMWAVEFORMQX

This routine sets the digital output channel specified to a PWM (pulse width modulator) signal.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API GeneratePWMWaveformQX( unsigned char
channel,  unsigned long samplespersecond, unsigned char dutycycle  );
```

- Channel: which channel (16 to C) to setup as a PWM output. 0 = channel 16, 7 = channel C
- Samplespersecond: how many samples per second for the PWM signal (1 to 390000)
- Dutycycle: a value from 0 to 100 for the low to high percentage of the PWM signal.

Return Value:

- 1 = Successful
- 0 = Failure

LOADDIGITALWAVEFORMQX

This routine sets the digital output channel specified to a PWM (pulse width modulator) signal.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API LoadDigitalWaveformQX( unsigned long
numberofsamples, unsigned char *samples  );
```

- Numberofsamples: a value from 1 to 61000 indicating the number of samples in the pattern
- Samples: a pointer to the buffer of samples. Each sample is a byte and are clocked out on consecutive sample clocks. Bit 0 of each byte is output channel 16, bit 7 is output channel C.

Return Value:

- 1 = Successful
- 0 = Failure

GENERATEDIGITALWAVEFORMQX

This routine sets the digital output channel specified to a PWM (pulse width modulator) signal.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API GenerateDigitalWaveformQX( unsigned char
channelmask, unsigned char GenerateOn, unsigned char loop,  unsigned char
```

```
waitT, unsigned char Trising, unsigned char externalclock, unsigned char
Crising, unsigned long samplespersecond);
```

- Channelmask: which channels to use for the output of the digital pattern generator. Bit 0 is channel 16 and Bit 7 is channel C. 1 = output digital pattern on this channel, 0 = no output.
- GenerateOn = 1 to turn on the pattern generator, 0 turns it off.
- Loop: 1 = loop the pattern at the end. 0 = No loop
- waitT: Waits to start the pattern until the T signal shows an edge
- Trising: indicates the T signal must be a rising edge (1) or falling edge (0) to trigger the pattern
- External Clock: 1 indicates to use the digital input C to clock out the pattern instead of the internal sample clock
- Crising: 1 indicates the external clock C rising edge, 0 = falling edge
- Samplespersecond is the number of samples per second to clock out the digital pattern (for internal clocking mode). 1 to 100,000,000

Return Value:

- 1 = Successful
- 0 = Failure

FREQUENCY AND PULSE COUNTER FUNCTIONS

The following API describes the routines that control the frequency and pulse counter functionality of the USBee QX Test Pod.

CLEARCOUNTSQX

This routine clears the frequency and pulse counts.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API ClearCountsQX( void );
```

Return Value:

- 1 = Successful
- 0 = Failure

ENABLECOUNTSQX

This routine enables the frequency and pulse counting.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API EnableCountsQX( void );
```

Return Value:

- 1 = Successful
- 0 = Failure

DISABLECOUNTSQX

This routine disables the frequency and pulse counting.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API DisableCountsQX( void );
```

Return Value:

- 1 = Successful
- 0 = Failure

GETFREQUENCYANDCOUNTSQX

This routine returns the frequency and pulse counting values.

Calling Convention

```
CWAV_IMPORT unsigned long CWAV_API GetFrequencyAndCountsQX( unsigned long
*edgecounts0, unsigned long *edgecounts1, unsigned long *edgecounts2,
unsigned long *edgecounts3, unsigned long *freq4, unsigned long *freq5,
unsigned long *freq6, unsigned long *freq7    );
```

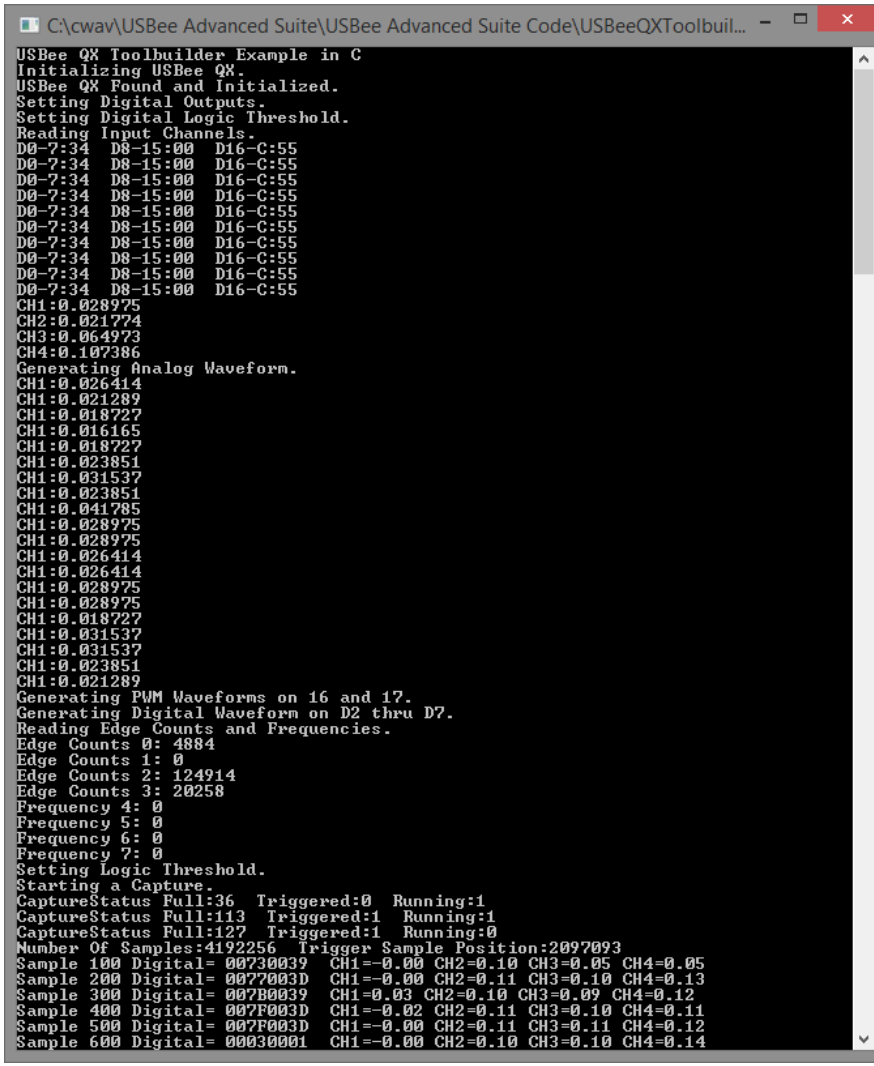
- Edgecounts0: how many edges were counted on digital channel 0
- Edgecounts1: how many edges were counted on digital channel 1
- Edgecounts2: how many edges were counted on digital channel 2
- Edgecounts3: how many edges were counted on digital channel 3
- Freq4: the frequency measured on digital channel 4
- Freq5: the frequency measured on digital channel 5
- Freq6: the frequency measured on digital channel 6
- Freq7: the frequency measured on digital channel 7

Return Value:

- 1 = Successful
- 0 = Failure

EXAMPLE C CODE

The following code listing is an example in very simple C that calls the DLL functions. It is a Command Prompt program that generates the following output when run.



File USBeeQXToolbulderInC.cpp

```
// USBeeQXToolbuilderInC.cpp : Defines the entry point for the console application.
//

#include "stdafx.h"
#include "conio.h"
#include "windows.h"

#define CWAV_API __stdcall
#define CWAV_EXPORT __declspec(dllexport)
#define CWAV_IMPORT __declspec(dllimport)

CWAV_IMPORT unsigned long CWAV_API InitializeQX( void );
CWAV_IMPORT unsigned long CWAV_API SetSignalsQX( unsigned long mask, unsigned long value  );
CWAV_IMPORT unsigned long CWAV_API SetAnalogChannelSettings( unsigned long  channel,  float range,
                        unsigned long DCCoupled  );
CWAV_IMPORT unsigned long CWAV_API SetLogicThresholdQX( float Thresh  );
CWAV_IMPORT float CWAV_API AnalogLiveVoltage( unsigned long channel );
CWAV_IMPORT unsigned long CWAV_API PowerOnAnalogQX(); // Turn on the Power to the Analog Channels
CWAV_IMPORT unsigned long CWAV_API PowerOffAnalogQX();// Turn off the Power to the Analog Channels
CWAV_IMPORT unsigned long CWAV_API GenerateAnalogWaveformQX( unsigned long SamplesPerSecond,
                        unsigned char SamplesPerCycle, unsigned char *samples );
CWAV_IMPORT unsigned long CWAV_API GeneratePWMWaveformQX( unsigned char channel,
                        unsigned long samplespersecond, unsigned char dutycycle  );
CWAV_IMPORT unsigned long CWAV_API LoadDigitalWaveformQX( unsigned long numberofsamples,
                        unsigned char *samples  );
CWAV_IMPORT unsigned long CWAV_API GenerateDigitalWaveformQX( unsigned char channelmask,
                        unsigned char GenerateOn, unsigned char loop,  unsigned char waitT,
                        unsigned char Trising,  unsigned char externalclock,  unsigned char Crising,
                        unsigned long samplespersecond);
CWAV_IMPORT unsigned long CWAV_API GetFrequencyAndCountsQX( unsigned long *edgecounts0,
                        unsigned long *edgecounts1, unsigned long *edgecounts2,
                        unsigned long *edgecounts3, unsigned long *freq4, unsigned long *freq5,
                        unsigned long *freq6, unsigned long *freq7    );
CWAV_IMPORT unsigned long CWAV_API ClearCountsQX( void );
CWAV_IMPORT unsigned long CWAV_API EnableCountsQX( void );
CWAV_IMPORT unsigned long CWAV_API DisableCountsQX( void );

CWAV_IMPORT unsigned long CWAV_API SetTriggersQX( int TrigXEnabled, int TrigYEnabled,
                        int TrigXorYEnabled, int TrigXandYEnabled, int TrigXthenYEnabled,
                        int TrigYthenXEnabled,int TrigX_DigitalEdgeEnabled,
                        int TrigX_AnalogEdgeEnabled, int TrigX_QualifyDigitalEnabled,
                        int TrigX_QualifyAnalogEnabled, int TrigX_QualifyTimeEnabled,
                        int TrigX_InvertDigitalQualifierEnabled,
                        int TrigX_InvertAnalogQualifierEnabled,
                        int TrigX_InvertTimeQualifierEnabled, int TrigX_DigitalEdgeChannel,
                        int TrigX_DigitalEdgeRising,  int TrigX_AnalogEdgeChannel,
                        int TrigX_AnalogEdgeRising, int TrigX_AnalogQualifierChannel,
                        int TrigX_AnalogQualifierFrom, int TrigX_AnalogQualifierTo,
                        int TrigX_AnalogTriggerLevel, long TrigX_DigitalQualifierChannelMask,
                        long TrigX_DigitalQualifierFrom, long TrigX_DigitalQualifierTo,
                        int TrigY_DigitalEdgeEnabled, int TrigY_AnalogEdgeEnabled,
                        int TrigY_QualifyDigitalEnabled, int TrigY_QualifyAnalogEnabled,
                        int TrigY_QualifyTimeEnabled, int TrigY_InvertDigitalQualifierEnabled,
                        int TrigY_InvertAnalogQualifierEnabled,
                        int TrigY_InvertTimeQualifierEnabled, int TrigY_DigitalEdgeChannel,
                        int TrigY_DigitalEdgeRising,  int TrigY_AnalogEdgeChannel,
                        int TrigY_AnalogEdgeRising, int TrigY_AnalogQualifierChannel,
                        int TrigY_AnalogQualifierFrom, int TrigY_AnalogQualifierTo,
                        int TrigY_AnalogTriggerLevel, long TrigY_DigitalQualifierChannelMask,
                        long TrigY_DigitalQualifierFrom, long TrigY_DigitalQualifierTo
                        );
CWAV_IMPORT unsigned long CWAV_API StartCaptureQX( unsigned long buffersize,
                        unsigned char TriggerPosition, float SampleRate, unsigned long channelmaskA,
                        unsigned long channelmaskB, unsigned char ExternalClockingOn,
                        unsigned char CompressionOn  );
CWAV_IMPORT unsigned long CWAV_API CaptureStatusQX( unsigned char *Full, unsigned char *Triggered,
                        unsigned char *Running );
CWAV_IMPORT unsigned long CWAV_API StopCaptureQX( void );
CWAV_IMPORT unsigned long CWAV_API TriggerNowQX( void );
CWAV_IMPORT unsigned long CWAV_API EndCaptureQX( __int64 *ActualNumberOfSamples,
                        __int64 *TriggerPosition);

CWAV_IMPORT unsigned long CWAV_API GetDigitalSignalsQX( unsigned char *digital0to7,
                        unsigned char *digital8to15, unsigned char *digital16toC );
```

```
CWAV_IMPORT unsigned long CWAV_API SampleDigitalData( __int64 index );
CWAV_IMPORT float CWAV_API AnalogSampleVoltage( unsigned long channel, __int64 index );
CWAV_IMPORT __int64 CWAV_API FindNextEdge( __int64 UCSample, unsigned long long channelmask,
                        unsigned long direction );

// Protocol Decoders
CWAV_IMPORT int CWAV_API DecodeSerial (unsigned __int64 *reserved1, unsigned char *OutFilename,
                        unsigned char *InlineFilename, __int64 StartSample, __int64 EndSample,
                        unsigned long Rate, unsigned long Channel,unsigned long AlignValue, unsigned
                        long AlignEdge, unsigned long AlignChannel,unsigned long UseAlignChannel,
                        unsigned long ClockChannel,unsigned long ClockEdge, unsigned long
                        BitsPerValue, unsigned long MSBFirst, unsigned long delimiter,unsigned long
                        hex, long BytesPerLine, char *ProtocolDefinitionFilename, char
                        *ProtocolOutputFilename, char *ErrorString);

CWAV_IMPORT int CWAV_API Decode1Wire (unsigned __int64 *reserved1, unsigned char *OutFilename,
                        unsigned char *InlineFilename, _int64 StartSample, __int64 EndSample,
                        long Rate, unsigned long Signal, long delimiter, long showall, long hex,
                        char *ProtocolDefinitionFilename, char *ProtocolOutputFilename,
                        char *ErrorString);

CWAV_IMPORT int CWAV_API DecodeI2S (unsigned __int64 *reserved1, unsigned char *OutFilename,
                        unsigned char *InlineFilename, __int64 StartSample, __int64 EndSample,
                        unsigned long Rate, unsigned long Channel, long BitOffset,
                        unsigned long AlignValue, unsigned long AlignEdge,
                        unsigned long AlignChannel,unsigned long UseAlignChannel,
                        unsigned long ClockChannel,unsigned long ClockEdge,
                        unsigned long BitsPerValue, unsigned long MSBFirst,
                        unsigned long delimiter,unsigned long hex, long BytesPerLine,
                        char *ProtocolDefinitionFilename, char *ProtocolOutputFilename,
                        char *ErrorString);

CWAV_IMPORT int CWAV_API DecodeASYNC (unsigned __int64 *reserved1,
                        unsigned char *OutFilename,unsigned char *OutTxFilename,
                        unsigned char *OutRxFilename, __int64 StartSample, __int64 EndSample,
                        long Rate, unsigned long TxChannel, unsigned long RxChannel,
                        unsigned long BaudRate, unsigned long Parity, unsigned long DataBits,
                        unsigned long Invert, unsigned long delimiter,unsigned long hex,
                        unsigned long ascii, long BytesPerLine, char *ProtocolDefinitionFilename,
                        char *ProtocolOutputFilename, char *ErrorString);

CWAV_IMPORT int CWAV_API DecodePS2 (unsigned __int64 *reserved1, unsigned char *OutFilename,
                        unsigned char *HostFilename, unsigned char *DeviceFilename,
                        __int64 StartSample, __int64 EndSample, long Rate,
                        unsigned long DataChannel, unsigned long ClockChannel,
                        unsigned long MSBFirst, long hex, char *ProtocolDefinitionFilename,
                        char *ProtocolOutputFilename, char *ErrorString);

CWAV_IMPORT int CWAV_API DecodeUSB (unsigned __int64 *reserved1, unsigned char *OutFilename,
                        unsigned char *InlineFilename, __int64 StartSample, __int64 EndSample,
                        long ShowEndpoint, long ShowAddress, long DPlus, long DMinus, long Speed,
                        long Rate, long SOF, long delimiter, long showall, long hex,
                        char *ProtocolDefinitionFilename, char *ProtocolOutputFilename,
                        char *ErrorString);

CWAV_IMPORT int CWAV_API DecodeSPIVariable (unsigned __int64 *reserved1,
                        unsigned char *OutFilename,unsigned char *InlineMOSIFilename,
                        unsigned char *InlineMISOFilename, __int64 StartSample, __int64 EndSample,
                        long Rate, unsigned long SS,unsigned long SCK,unsigned long tMOSI,
                        unsigned long tMISO, unsigned long MISOEdge,unsigned long MOSIEdge,
                        unsigned long delimiter,unsigned long hex,unsigned long UseSS,
                        unsigned long SSLevel, long BytesPerLine, long BitsPerByte,
                        char *ProtocolDefinitionFilename, char *ProtocolOutputFilename,
                        char *ErrorString);

CWAV_IMPORT int CWAV_API DecodeI2C (unsigned __int64 *reserved1, unsigned char *OutFilename,
                        unsigned char *InlineSDAFilename, __int64 StartSample, __int64 EndSample,
                        long Rate, unsigned long SDA, unsigned long SCL, long showack,
                        long delimiter, long showall, long hex, char *ProtocolDefinitionFilename,
                        char *ProtocolOutputFilename, char *ErrorString);

CWAV_IMPORT int CWAV_API DecodeCAN (unsigned __int64 *InputDecodeBuffer, unsigned char *OutFilename,
                        unsigned char *InlineFilename, __int64 StartSample, __int64 EndSample,
                        unsigned long Rate, unsigned long Channel, unsigned long BitRate,
                        unsigned long maxID, unsigned long minID, long delimiter, long showall,
                        long Phex, char *ProtocolDefinitionFilename, char *ProtocolOutputFilename,
                        char *ErrorString);
```

```
CWAV_IMPORT int CWAV_API DecodeParallel (unsigned __int64 *reserved1, unsigned char *OutFilename,
                        unsigned char *InlineFilename, __int64 StartSample, __int64 EndSample,
                        long Rate, unsigned long Channels,unsigned long Clock, unsigned long UseCLK,
                        long CLKEdge, unsigned long delimiter,unsigned long hex, long BytesPerLine,
                        char *ProtocolDefinitionFilename, char *ProtocolOutputFilename,
                        char *ErrorString);

CWAV_IMPORT int CWAV_API DecodeSetName (char *name);

#define DC_COUPLED      1
#define AC_COUPLED      0


int _tmain(int argc, _TCHAR* argv[])
{

     printf( "USBee QX Toolbuilder Example in C\n");

     printf( "Initializing USBee QX.\n");

     if (!InitializeQX())
     {
          printf( "No USBee QX Found.\n");
     }
     else
     {
          printf( "USBee QX Found and Initialized.\n");

          PowerOnAnalogQX(); // Turn on the power to the Analog channels CH1, CH2, CH3 and CH4

          printf( "Setting Digital Outputs.\n");
          SetSignalsQX( 255, 0  );
          SetSignalsQX( 255, 0xFF  );
          SetSignalsQX( 255, 0xAA  );
          SetSignalsQX( 255, 0x55  );

          printf( "Setting Digital Logic Threshold.\n");
          SetLogicThresholdQX( 1.5 );

          // Setup the Analog input channels
          SetAnalogChannelSettings( 1,  6, DC_COUPLED );
          SetAnalogChannelSettings( 2,  6, DC_COUPLED );
          SetAnalogChannelSettings( 3,  6, DC_COUPLED );
          SetAnalogChannelSettings( 4,  6, DC_COUPLED );

          printf( "Reading Input Channels.\n");

          for (int x = 0; x < 10; x++)
          {
               unsigned char D0to7;
               unsigned char D8to15;
               unsigned char D16toC;
               GetDigitalSignalsQX( &D0to7, &D8to15, &D16toC  );
               printf("D0-7:%02X  D8-15:%02X  D16-C:%02X  \n",  D0to7, D8to15, D16toC  );
          }

          float CH1Volts = AnalogLiveVoltage( 1 );
          float CH2Volts = AnalogLiveVoltage( 2 );
          float CH3Volts = AnalogLiveVoltage( 3 );
          float CH4Volts = AnalogLiveVoltage( 4 );
          printf("CH1:%f\n", CH1Volts);
          printf("CH2:%f\n", CH2Volts);
          printf("CH3:%f\n", CH3Volts);
          printf("CH4:%f\n", CH4Volts);



          printf( "Generating Analog Waveform.\n");
          unsigned char samplebuffer[128];
          for (int x = 0; x < 128; x++) samplebuffer[x] = x;
          GenerateAnalogWaveformQX( 100, 128, samplebuffer );

          for (int x = 0; x < 20; x++)
               printf("CH1:%f\n", AnalogLiveVoltage( 1 ));
```

```
printf( "Generating PWM Waveforms on 16 and 17.\n");
GeneratePWMWaveformQX( 0,  1000, 50  );
GeneratePWMWaveformQX( 1,  20000, 25  );

printf( "Generating Digital Waveform on D2 thru D7.\n");
LoadDigitalWaveformQX( 128, samplebuffer  );
GenerateDigitalWaveformQX( 0xFC, 1, 1,  0,  0,  0,  0, 3000000);

printf( "Reading Edge Counts and Frequencies.\n");
DisableCountsQX();
ClearCountsQX();
EnableCountsQX();

Sleep(100);

unsigned long ec0, ec1, ec2, ec3, f4, f5, f6, f7;
GetFrequencyAndCountsQX( &ec0, &ec1, &ec2, &ec3, &f4, &f5, &f6, &f7  );
printf("Edge Counts 0: %ld\n", ec0);
printf("Edge Counts 1: %ld\n", ec1);
printf("Edge Counts 2: %ld\n", ec2);
printf("Edge Counts 3: %ld\n", ec3);
printf("Frequency 4: %ld\n", f4);
printf("Frequency 5: %ld\n", f5);
printf("Frequency 6: %ld\n", f6);
printf("Frequency 7: %ld\n", f7);

printf( "Setting Logic Threshold.\n");
SetLogicThresholdQX( 1.5 );

printf( "Starting a Capture.\n");

// Setup the Trigger Specification
SetTriggersQX( false, false, false, false, false, false, // No trigger, trigger always
            false, false, false, false, false, false, false, false, 0, false,  1, false,
            1, 1.0, 3.0, 1.5, 0xFFFF, 0x0000, 0xFFFF,       // Trigger X Event
            false, false, false, false, false, false, false, false, 0, false,  1, false,
            1, 1.0, 3.0, 1.5, 0xFFFF, 0x0000, 0xFFFF);      // Trigger Y Event

// Start the capture
unsigned long SampleBufferSize = 4*1024*1024;                 // 4 Million
unsigned char TriggerPosition = 50; // 50 percent (trigger in the middle)
float SampleRate = 100000000; // 100Msps
unsigned long ChannelMaskA = 0xFFFFFFFF; // Sample all channels (D0-15, CH1 and CH2)
unsigned long ChannelMaskB = 0xFFFFFFFF; // Sample all channels (D16-23, CH3 and CH4)

StartCaptureQX(SampleBufferSize, TriggerPosition, SampleRate, ChannelMaskA, ChannelMaskB,
               0, 0  );

// Monitor the status of the capture in progress
unsigned char Full;
unsigned char Triggered;
unsigned char Running = 1;

while( Running )
{
     CaptureStatusQX( &Full, &Triggered, &Running );
     printf("CaptureStatus Full:%d Triggered:%d Running:%d\n", Full, Triggered,Running );
     Sleep(10);
}

//TriggerNowRX();  // To trigger now and store data to the end of the buffer
//StopCaptureRX(); // To stop capture in progress and discard the data

// Now that the capture completed, properly end the capture and get the data
__int64 ActualNumberOfSamples;
__int64 TriggerSamplePosition;

// Completes the capture and transfers all of the stored data to the PC
EndCaptureQX( &ActualNumberOfSamples, &TriggerSamplePosition);

printf("Number Of Samples:%I64d  Trigger Sample Position:%I64d  \n",
          ActualNumberOfSamples, TriggerSamplePosition );

// Now access samples captured using SampleDigitalData() and AnalogSampleVoltage()
for (int x = 100; x < 12000; x+=100)
     printf("Sample %2d Digital= %08X  CH1=%0.2f CH2=%0.2f CH3=%0.2f CH4=%0.2f\n", x,
       SampleDigitalData(x), AnalogSampleVoltage( 1, x ), AnalogSampleVoltage( 2, x ),
        AnalogSampleVoltage( 3, x ), AnalogSampleVoltage( 4, x ));
```

```
            __int64 NextSampleWithEdge = FindNextEdge(1234567, 0xFFFF, 1);

        }

        PowerOffAnalogQX();// Turn off the power to the Analog channels CH1, CH2, CH3 and CH4

        printf( "Press any key to exit.\n");
        getch();

        return 0;
}
```

USBEE QX SUITE PRO MODULE

The USBee QX Suite Pro Module is an optional module that provides additional features to the USBee QX Suite.

The optional USBee QX Suite Pro software module adds the following features to the platform:

- Spectrum Analyzer
- Protocol Field Graphing

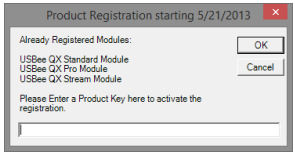
REGISTERING THE MODULE

In order to register software modules, you must have:

- USBee QX Suite software suite installed on the PC
- USBee QX pod connected and functioning on the PC
- Internet access on the PC

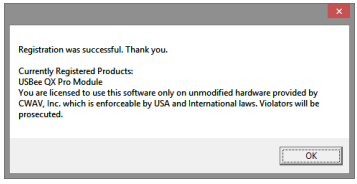
The software module is linked to the USBee QX pod, and not the PC. You can install the USBee QX Suite software and add-on modules on as many PCs as you want. The add-on module will only function with the USBee QX pod that it was initially register with. Finally, you can not register the module without the USBee QX plugged in.

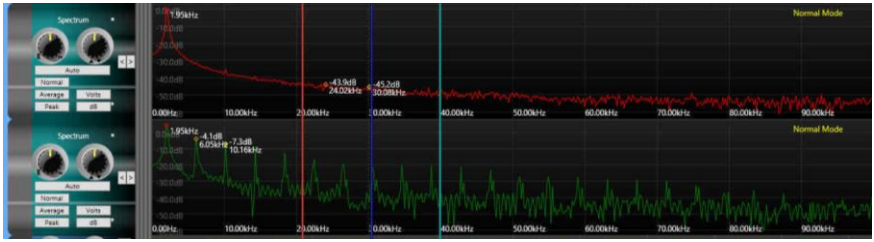
First, to enable the USBee QX Suite Pro Module, select the Setup / Register USBee QX Suite Module menu. This brings up the following screen:



Next, copy and paste the Product Key you received into the box and press OK. You will have received the Product Key on your on-line invoice when you purchased the module.

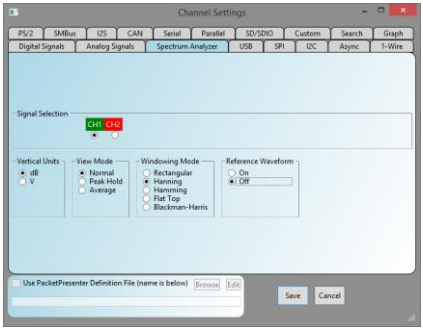
The software will contact our servers to validate the Product code and return with the following screen on success. The module is now installed and ready to be used.


Registration was successful. Thank you.
Currently Registered Products:
USBee QX Pro Module
You are licensed to use this software only on unmodified hardware provided by CWAV, Inc. which is enforceable by USA and International laws. Violators will be prosecuted.
OK



The Spectrum Analyzer feature displays the FFT Spectrum Analysis of the selected Analog Channel.

Once the analog channel you want to analyze is captured, you can add a Spectrum Analyzer waveline. To setup a Spectrum Analyzer waveline, click the grey tab at the left of a waveline (or add a new one by pressing the "+" symbol) and select the Spectrum Analyzer tab as below.



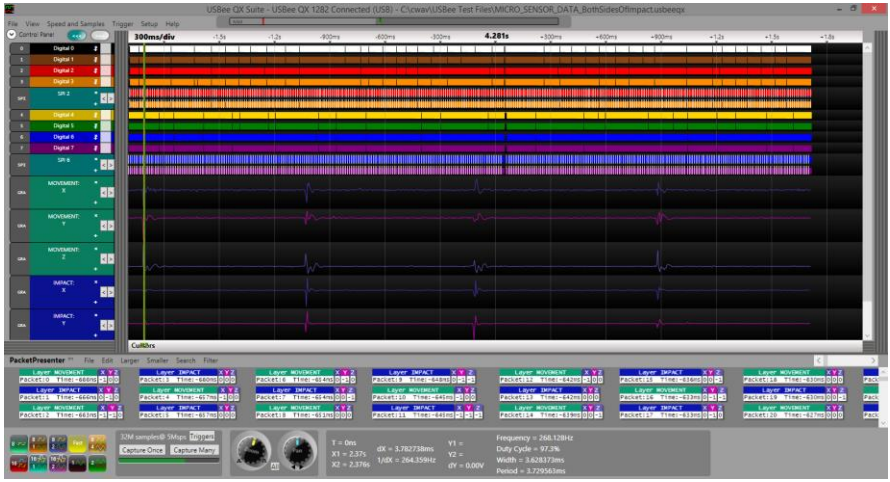
The spectrum can be displayed in a variety of formats.

- **Normal** – Displays the FFT analysis of the analog channel waveform section that is displayed on the screen.
- **Average** – Displays the average of the spectrum of 128 consecutive traces.
- **Peak** – Displays the Peak value of the last 128 consecutive traces.
- **Volts** – Displays the graph in linear Volts units
- **dB** – Displays the graph in logarithmic dB units
- **Rectangular, Hanning, Hamming, Flat Top, and Blackmann Harris** – The windowing algorithm applied to the spectrum.

You can adjust the display using the Scaling and Offset knobs on the left to move the waveform where you need it. You can also press the **Auto** button to auto scale the wavefrom to fit completely in the window.

Hovering the cursor over the waveform will place a marker with the measured level and frequency. The top three peaks are also found and marked automatically.

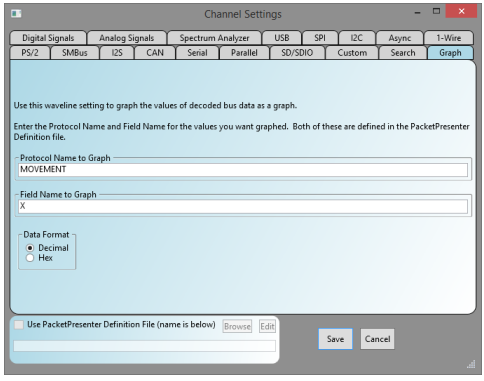
PROTOCOL FIELD GRAPHING



Protocol Field Graphing gives you a visual display of any of the protocol fields in-line with your traces. This allows you to see the values of acceleration, temperature, audio or any other digital data contained in your bus protocols. The above screenshot shows the graphing of the X, Y and Z acceleration of two accelerometers on the opposite side of an impact.

The data that is graphed comes directly from the PacketPresenter output for a decoded bus line. As seen in the above screenshot, the PacketPresenter is showing decoded packets that contain the fields that we want to graph. For setting up the PacketPresenter, refer to the PacketPresenter chapters.

Once the PacketPresenter is decoding the fields you want to graph, you can add a graphing waveline. To setup a Protocol Graphing waveline, click the grey tab at the left of a waveline (or add a new one by pressing the "+" symbol) and select the Graph tab as below.



Enter the Protocol Name to Graph. This is the label that is displayed at the start of each PacketPresenter packet and comes directly from the PacketPresenter Definition file that was used to decode the traffic.

Next enter the Field Name to graph. This is the top label of the field that you want to graph. In the above example we used the X, Y or Z fields – one for each graphed line.

Finally, select whether the field data is in Hex or Decimal format.

The graph line is then computed and displayed. The scaling of the graph is automatic to fit all points within the display area. Hovering the cursor over the graph will place a marker and show the value of the point at that location.

USBEE QX STREAMING MODULE

The USBee QX Streaming Module is an optional module that greatly enhances the capture duration of certain signals by streaming sample data directly to disk. This module has been requested by many customers who want to capture signals for hours and analyze their data that won't fit in the interal 32M sample buffer.

The USBee QX Streaming Module compresses the sample stream and sends it to the PC to store on the hard disk. This lets the sample buffer to be up the the size of the hard disk (100's of GBytes) instead of the onboard 32 M sample buffer. The only limitation is that the bandwidth needed must be achievable. This is explained below.

STREAMING BANDWIDTH

The key to successful sample streaming is the overall bandwidth that your setup can achieve versus the signals being captured. As long as the bandwidth needed is less than what can be achieved then your stream can last until your disk limit is reached. During streaming capture you will see the overall average transfer bandwidth as well as if any data was lost due to a bandwidth mismatch.

The bandwidth your system can achieve is based on the slowest of following:

- USB Transfer Speed – USB 3.0 connection gets typically 150-250Mbytes/sec
- Disk Write Speed – Hard Disks, SSD or RAM disks have their own write limitations. For fastest captures use SSD or RAM disk drives.

The bandwidth your captured signals require is based on the following:

- Number of channels captured – 7 Digital (1 Byte/sample) or 15 Digital (2 Bytes/sample)
- The number of edges on your signals – Each edge is stored in 2 samples

The samples are taken at 100Msps giving a sample resolution of 10ns. The onboard 32MSample buffer is also used as a FIFO buffer that allows for bursts of high throughput transactions.

For example, capturing a 100% utilized I2C bus running at 100kHz SCL would have the following bandwidth. Each SDA clock is 2 edges, giving 200k edges/sec. Each edge is stored in 2 samples giving 400k samples/sec. If we capture in the 15 Digital Channels mode, that is 2 bytes per sample, giving a needed bandwidth of 800k Bytes/second bandwidth. This bandwidth is easily achievable on any PC system. The resulting storage duration then is the disk file size limit divided by 800k. For a disk file of size 100G you can store this bus for 125,000 seconds, or 34.7 hours. Obviously if the bus is not operating continuously the capture time will be longer proportional to the amount of utilization.

As another example, 50MHz SDIO can also be captured and streamed to disk. Although the instantanious capture bandwidth of the transactions is beyond the write bandwidth of many hard disks (> 200Mbytes/sec), the onboard 32Msps buffer can store the fast samples and be used as an elasticity buffer. As long as the average bus utilization is within the streaming bandwidth it can store the transactions.

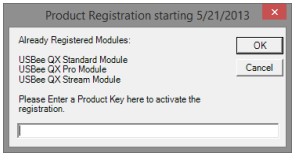
REGISTERING THE MODULE

In order to register software modules, you must have:

- USBee QX Suite software suite installed on the PC
- USBee QX pod connected and functioning on the PC
- Internet access on the PC

The software module is linked to the USBee QX pod, and not the PC. You can install the USBee QX Suite software and add-on modules on as many PCs as you want. The add-on module will only function with the USBee QX pod that it was initially register with. Finally, you can not register the module without the USBee QX plugged in.

First, to enable the USBee QX Suite Pro Module, select the Setup / Register USBee QX Suite Module menu. This brings up the following screen:



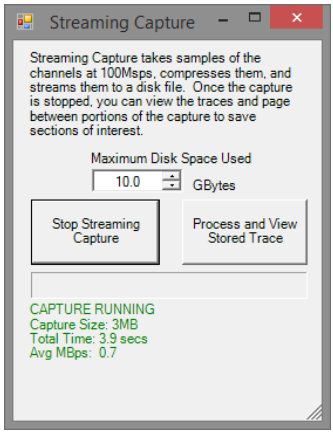
Next, copy and paste the Product Key you received into the box and press OK. You will have received the Product Key on your on-line invoice when you purchased the module.

The software will contact our servers to validate the Product code and return with the following screen on success. The module is now installed and ready to be used.

USING DISK STREAMING

To setup a streaming capture, select the Streaming to Disk menu. You can specify on this menu one of 2 channel modes to capture. Digital 0-7 mode uses one byte per sample and Digital 0-15 mode uses 2 bytes per sample.

Then to start a capture, select Streaming to Disk / Capture Stream to Disk menu item. The following dialog box is then displayed.


Streaming Capture
Streaming Capture takes samples of the channels at 100Msps, compresses them, and streams them to a disk file. Once the capture is stopped, you can view the traces and page between portions of the capture to save sections of interest.
Maximum Disk Space Used
10.0
GBytes
Stop Streaming Capture
Process and View Stored Trace
CAPTURE RUNNING
Capture Size: 3MB
Total Time: 3.9 secs
Avg MBps: 0.7

Enter the size limit on the file you want to store to your drive. This will stop the capture when this limit is reached.

Then press the **Start Streaming Capture** button. Streaming will begin and the Capture Size (Mbytes), Total Time and Average Mbytes/second stored will be displayed. If data has been dropped due to insufficient write bandwidth you will see an OVERFLOW message as well.

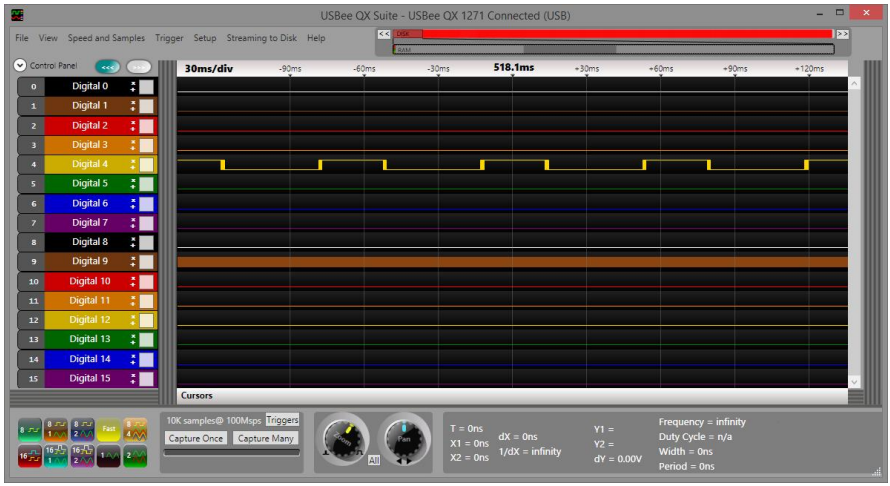
Once the capture completes, or you press Stop it will display a READY for PROCESSING message. Since stored files can be 100's of GBytes it is not automatically processed as it can take many minutes to process large files.

To process a capture for display press the **Process and View Stored Trace** button. It will read the entire trace and prepare the system for displaying the trace. You can also choose to process the streamed file at a later time. If the stream trace has already been processed previously, the data is loaded and displayed.

Only one stream file is maintained at a time. Once a new stream is started, the previous stream is removed. This is specifically to eliminate the creation of multiple 100G files on your drives. Each stream is displayed and sections can be saved to disk as non-streamed captures using the Save As File menu.

VIEWING THE DISK STREAM

Once the capture stream is processed the first block of the stream is loaded and displayed as seen below.



The bars at the top of the screen show the complete stream available on the disk, and what portion of that stream is in RAM and shown on the waveform. To load different portions of the stream you can click on the “disk” image bar to load that portion of the stream, or you can click on the left << or right >> buttons to load the previous or next sections. The Disk bar is color coded to show relative capture activity at that time during the stream.

You can then use any of the USBee Suite features including Save Capture to save off that portion of the stream capture.

EXTERNALLY PROCESSING THE DISK STREAM

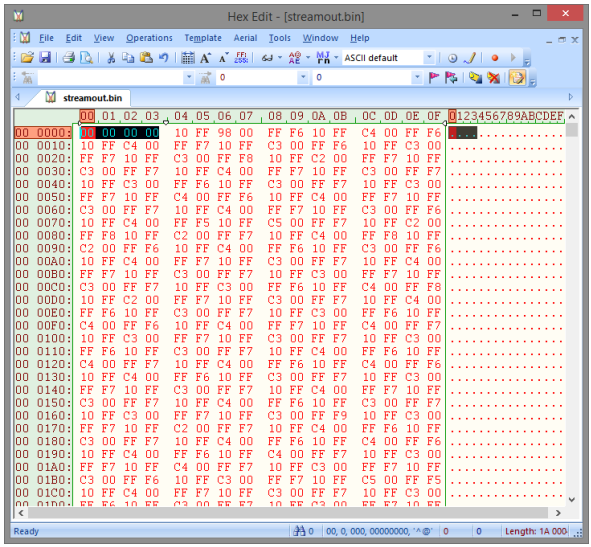
The capture file can be post processed externally by your external programs. This section defines the format of the sample file.

The stream file is located at C:\Users\(Username)\AppData\Local\USBeeSuite\streamout.bin

7 SIGNAL CAPTURE MODE

The below hex dump is from a 7 signal capture where each byte contains a sample as described below. The stream starts with a 00 00 00 00 which indicates this is a 7 signal capture. Following these 4 bytes are the streamed samples.

This is a capture of an approximately 228.5kHz signal on channel 4.



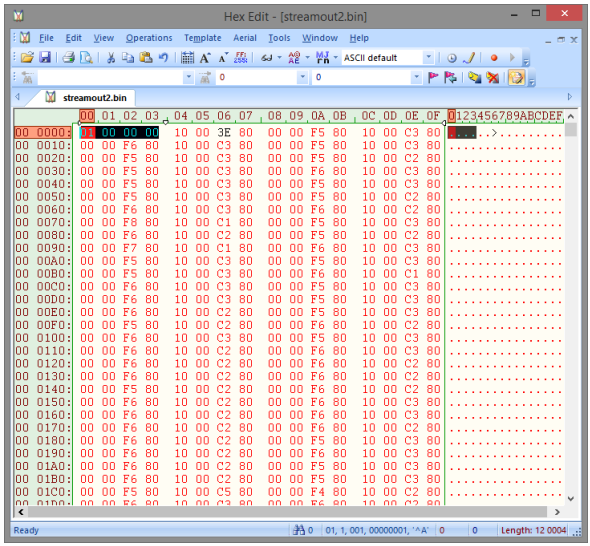
The format of the samples in the streaming file is a simple runlength encoded pattern. When sampling in seven signal mode (D0-D6) each byte is a sample with the MSB indicating if it is a RLE count or not. If the eighth bit is set to a one, the low 7 bits is a RLE count. If bit eight is a zero then the low bits are the digital state of those signals for that one clock sample (D0-D6). For example, a 0x00 followed by a 0x85 is six samples with all digital channels D0-D6 at logic level zero. And since each sample is taken at 100.8 MHz you can compute the time by counting the samples.

RLE counts can be concatenated as many times as needed.

15 SIGNAL CAPTURE MODE

The below hex dump is from a 15 signal capture where two bytes contain a sample as described below. The stream starts with a 01 00 00 00 which indicates this is a 15 signal capture. Following these 4 bytes are the streamed samples.

This is a capture of an approximately 228.5kHz signal on channel 4.



The format of the samples in the streaming file is a simple runlength encoded pattern. When sampling in 15 signal mode (D0-D14) each byte is a sample with the MSB indicating if it is a RLE count or not. If the MS bit is set to a one, the low 15 bits is a RLE count. If the MS bit is a zero then the low bits are the digital state of those signals for that one clock sample (D0-D14). For example, a 0x0000 followed by a 0x8005 is six samples with all digital channels D0-D14 at logic level zero. And since each sample is taken at 100.8 MHz you can compute the time by counting the samples.

RLE counts can be concatenated as many times as needed.

GETTING HELP

We are always eager to help you to get the most out of all USBee products. If you have any questions, comments, bug reports or suggestions, please contact us. We actively improve our product line and your feedback is the key to making the USBee the best embedded development tool on the market.

Email us at support@usbee.com

or

Call us at (951) 694-6808

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